PLATE NO. 16.

Photo-Lith. by the Burland-Desbarats Lith. Co.

RESTIGOUCHE BRIDGE.

(View from the New Brunswick side of River.)

See page 166.

THE

INTERCOLONIAL.

A HISTORICAL SKETCH

OF THE

INCEPTION, LOCATION, CONSTRUCTION AND COMPLETION OF THE LINE OF RAILWAY UNITING THE

INLAND AND ATLANTIC PROVINCES

OF THE

DOMINION,

WITH MAPS AND NUMEROUS ILLUSTRATIONS.

BY SANDFORD FLEMING, C. E.,
ENGINEER-IN-CHIEF OF THE NEWFOUNDLAND, INTERCOLONIAL AND CANADIAN PACIFIC RAILWAYS.

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1876.

THE HONOURABLE ALEXANDER MACKENZIE,

MINISTER OF PUBLIC WORKS AND PREMIER OF CANADA.

SIR,

As the Intercolonial Railway is now in a position to be opened for traffic, it is my duty, as Chief Engineer, to submit a final Report on its condition.

A Report such as the usual course prescribes, would necessarily be professional and technical, and would be confined to a description of the results which have been effected, and a statement of the cost at which these have been attained.

But the Intercolonial Railway is national in its objects and character, and to my mind it calls for more extended consideration. As the head of the Department of Public Works, and as the Minister who has directed the concluding operations on the Railway, you have been good enough to acquiesce in the view, that a barren relation of figures and detail would be insufficient and unsatisfactory.

I have therefore felt it incumbent upon me to depart from the course generally followed on such occasions.

I have endeavoured, in the following pages, to give the early his-

tory of the Railway, and to trace the causes which prevented the adoption of a direct route, and in this connection I have been led to review the negotiations which ended in the establishment of the Maine Boundary. I have endeavoured to describe the frequent fruitless attempts which were subsequently made to obtain the means of constructing the line, and the considerations which led to the adoption of the present route. In cases where the location is open to criticism, I have given a narrative of the events which enforced its determination, I have stated the principles which governed the construction of the Railway, and I have described several of the most important structures; at the same time I have briefly set forth the character of the country through which the Railway passes.

Although it may be said that the present volume includes much beyond the sphere of my official duties, I venture to hope that the course pursued by me will meet with your approval, and I trust that you will believe that I have striven honestly, to place on record what has passed under my own notice, and what I have gathered from official documents and from public records.

Thirteen years have passed since my first appointment as Chief Engineer,—a duty assigned to me by the Imperial and Provincial Governments at the commencement of the Survey. At that period a long tract of wilderness separated the Maritime from the Inland Provinces. The Railway, which now connects them, I may venture to assert, will rank second to none on this Continent. In the embellishment of its structures it may be surpassed by the lines of the old world, but in the essentials of a Railway, it will, when entirely completed, have no superior.

Some further expenditure is still necessary, but the Railway is in

a condition to be opened for traffic throughout its entire length, therefore my official relations with the work may now terminate.

In placing this volume before you, I feel that I am performing the last act of duty, in the office I have long held, and that I am separating myself from a work, to the prosecution of which, with many friends and fellow-labourers, I have devoted for many years the best energies of my life. A connection of this kind is not broken without an effort; but any personal considerations must disappear in view of the completion of a work, which realizes the national aspirations of half a century, by bringing within a few hours, the old fortress of Halifax and the older Citadel of Quebec, and which must form an important section of the Railway, destined, ere long, to extend from East to West through the entire Dominion.

I am, Sir,

Your Obedient Servant,

SANDFORD FLEMING.

OTTAWA, 1st July, 1876.

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INTERCOLONIAL RAILWAY.

CHAPTER I.

EARLY HISTORY, 1832 TO 1842.

Early suggestions of a Railway System for Canada.—Henry Fairbairn's Extraordinary foresight.—An Intercolonial Railway first projected.—Exploration of the Route.—Smith and Hatheway's Report.—The project meets the approbation of the Lower Canada Legislature.—Opinions of Captain Yule, R. E.—St. John's press advocates the scheme.—Deputation to England—Imperial Government grants £10,000—Survey Commenced under Captain Yule, R. E.—Engineering character of Route favourable.—Western Traffic to be competed for.—Opinions of the New York Press on the "Great Project."—Cupidity of the people of the United States.—Interference of the State of Maine.—Suspension of the Survey.—Lord Durham.—The Kempt Road.

THE project of an Intercolonial Railway, to connect the Maritime Provinces with the Canadas, early occupied public attention. Few are aware that among the first consequences of the stimulus given to progress, throughout the world, by the creation of the Railway system, we must assign a prominent position to the consideration of a scheme for connecting Halifax with St. John, and the Bay of Fundy with the St. Lawrence.

The Stockton and Darlington Railway, of which the fiftieth anniversary was celebrated last autumn, had been but a few years in operation, when British North America became awakened to the necessity of establishing the Railway system within her territory as a relief to the disability under which she was labouring. Although the

influence it was destined to exercise upon the world was at that time but imperfectly understood by the mass of men, some minds foresaw the power which it possessed to develope the resources of a country. They were but few, and it was only by slow degrees that the generation which witnessed its introduction appreciated the revolution it would accomplish.

Extraordinary as it may seem, a writer who may be classed with the few far-seeing men who lived two generations ago, turned his views across the Atlantic and suggested the construction of Railways in British America as a means of promoting her progress.

The Stockton and Darlington line, the first in the series of English passenger Railways, indeed, the first of the kind in any part of the world, was opened on the 27th September, 1825. In the United Service Journal of 1832, Mr. Henry Fairbairn, the writer in question, published the first notice, so far as known, of a project for applying the Railway system to Canada. He says: "I propose, first to form a Railway for "wagons, from Quebec to the Harbour of St. Andrews upon the Bay of "Fundy, a work which will convey the whole trade of the St. Law-"rence, in a single day, to the Atlantic waters. Thus the timber, pro-"visions, ashes, and other exports of the Provinces may be brought to "the Atlantic, not only with more speed, regularity and security, than "by the river St. Lawrence, but with the grand additional advantage "of a navigation open at all seasons of the year; the harbour of St. "Andrews being capacious, deep, and never closed in the winter season, "whilst the St. Lawrence is unnavigable from ice, from the month of "November to May. Another great line of railway may be formed from "Halifax, through Nova Scotia to St. John's, in the Province of New "Brunswick, and thence into the United States, joining the railways "which are fast spreading through that country, and which will soon "reach from New York to Boston and through the whole New England "States. This railway will not only bring to the Atlantic the lumber, "provisions, metal, and other exports of the provinces, but from the "situation of the harbour of Halifax, it will doubtless command the

"whole stream of passengers, mails, and light articles of commerce pass-"ing into the British possessions and to the United States and every "part of the continent of America.

"Indeed, if the difficulties and expense of constructing these works "in our North American Colonies were tenfold greater, an imperative "necessity would exist for their adoption, if it is desired by the Govern-"ment of this country, to maintain an equality of commercial advan-"tages with the neighbouring United States. For the splendid "advantages of the railway system are well understood in that country, "where great navigable rivers are about to be superseded by railways "of vast magnitude, reaching over hundreds of miles. Indeed, in no "country, will the results of the railway system be so extensive as in "the United States, for it will assimilate their only disadvantage, in-"land distance from the sea; and it will effect the work of centuries to "connect, consolidate, and strengthen that giant territory, lying beneath "all climates and spreading over a quarter of the globe. If then we "would contend with these advantages, in our North American Prov-"inces, it is only by similar works, that we can bring to the Atlantic, "the agricultural exports of the Colonies, and secure the stream of "emigration, which otherwise, with the facility of inland transportation, "will be rapidly diverted to the Western regions of the United "States."

These words were penned forty-four years ago and they are worthy of preservation, not only for the correctness of view expressed and for the enunciation of a policy which has been entirely carried out, but for the modern language and tone in which the writer clothed his argument. The mind which, in those days, could judge what railways would effect, and could foreshadow what has taken half a century to accomplish, must have been of no ordinary kind, and, on the completion of the Intercolonial Railway it seems a fitting time to remember Henry Fairbairn and mention his name with honour.

St. Andrews, on the Bay of Fundy, was then an important centre of business in New Brunswick, and the mention of the part assigned

to that locality in this scheme at once attracted public attention there. The commercial importance of the undertaking was immediately recognized and its active population lost no time in putting into practical form the policy which Mr. Fairbairn had pointed out for it to follow; a meeting was called on the 5th October, 1835, at which resolutions advocating the line of Railway were unanimously carried.

More than ordinary interest is attached to these proceedings as they may be held to be the first step taken towards the consummation of the project. The resolutions enunciated the necessity of a Railway from Canada to the nearest winter port in New Brunswick, viz., St. Andrews, the national importance of the project, and the prospect that it would be remunerative. The resolutions further set forth that an association be formed to promote the building of a Railway. The association was at once organized and an executive committee appointed.*

A deputation was also named to wait upon Sir Archibald Campbell, then Lieutenant-Governor of New Brunswick, to demonstrate the advantages which must result from the scheme and to solicit his assistance. The Lieutenant-Governor expressed his appreciation of the zeal and enterprise which suggested a project so well calculated to prove beneficial, commercially and in every other respect; and promised to support the project. The association appointed Mr. George H. Smith and Mr. E. R. Hatheway to explore the territory; so that the feasibility of the undertaking could be ascertained, and the character of the difficulties in the way made known. These gentlemen reported in January, 1836. The route followed by them was in part that which the present New Brunswick & Canada Railway has taken from St. Andrews northward to Woodstock, thence it proceeded up the valley of the river St. John as far as the point called Mars Hill, about 120 miles from St. An-

* Hon. Jas. Allanshaw, Chairman.
Thomas Wyer, Esq., Deputy Chairman.
Harris Hatch,
John Wilson,
James Rait, } Committee of Management.
Samuel Frye,
J. McMaster,
Adam Jack Secretary and Treasu

drews, and then turned nearly Westward towards Quebec, ending on the height of land between the waters of the river St. John and the St. Lawrence. The exploration was not continued farther than this height of land, owing to an examination having been previously made through the district lying between it and the city of Quebec, by Captain Yule of the Royal Engineers. The latter exploration had been carried on under the authority of Lord Aylmer, Governor-General of Canada. The report of Messrs. Smith and Hatheway declared that no obstructions had been met to impede the formation of the Railway, that a great portion of the lands were fit for settlement, and no burnt tracts had been found. The work was pronounced by the explorers to be less difficult than was expected. During the progress of the survey, the association appealed to public opinion, and a verdict was pronounced unmistakably in its favor. In this state of affairs it became advisable to communicate with Lower Canada; accordingly in December, 1835, a deputation proceeded to Quebec, to bring the matter under the notice of the Government. Resolutions favorable to the undertaking were adopted in the same month by both Houses of the Legislature. The resolutions of the Legislative Council bear date 19th December. They are highly laudatory of the project, and promise the passing of a law authorizing the construction of the Railway, recommending at the same time the work to the consideration of the Imperial authorities.*

Similar Resolutions were adopted by the House of Assembly the ensuing week.

The inhabitants of Quebec and Montreal equally expressed sympathy in the undertaking. The Boards of Trade of both cities joined the association, and special committees were appointed to act in concert with the deputation.

* That a railroad between the port of St. Andrews, in the Bay of Fundy, which is open at all seasons of the year, and the port of Quebec, would greatly diminish the disadvantage under which this province labours from the severity of its climate and the consequent interruption of the navigation of the River St. Lawrence. That the opening of such communication between the points before mentioned would promote the settlement of the country, greatly facilitate the intercourse between these provinces and the United Kingdom, extend the interchange of commodities between the British possessions in America, increase the

In compliance with the wish of the deputation, Captain Yule, R. E., who had made the exploratory survey between Quebec and the height of land, placed on record the expression of his opinion, that the scheme was beyond the ordinary limits of commercial speculation; that it was even something more than inter-provincial in its character; that it included the greater object of reducing the time necessary to pass between Europe and America.

In St. John, New Brunswick, a deep interest was felt in the scheme, and, although a degree of rivalry existed between that place and St. Andrews, the press of St. John gave its support to the project.*

In January, 1836, a deputation proceeded to England, carrying with them a petition to the King, and remained there engaged in negotiation with the Imperial Government until the following June.

During March, resolutions similar to those passed by the Legislature of Lower Canada were carried in the House of Assembly, Nova Scotia; and in the same month a bill passed the Legislature of New Brunswick,

demand for British manufactures, and be the means of affording additional employment to British shipping. That for the foregoing reasons it is highly expedient to promote and facilitate the views of the Saint Andrews and Quebec Railroad Company Association, and that so soon as the Legislature of the province of New Brunswick shall have passed an Act to establish a railroad between Saint Andrews and the province line, every facility ought to be given to the enactment of a law of a similar nature upon conditions as favourable as may have been granted to any railroad company within this province.

That an humble address be presented to His Excellency, the Governor-in-Chief, praying that His Excellency will be pleased to transmit the above Resolutions to the Secretary of State for the Colonial Department, as the opinion of the Legislative Council, upon the subject to which it has reference; and praying also that His Excellency will be pleased to recommend the subject to the favourable consideration of His Majesty's Government, if His Excellency shall think fit to do so."

* We most sincerely hope that this grand projection may receive the favourable consideration of the King and his government. The great importance of connecting these two ports by railroad will at once be seen, when we remind our readers that Quebec is bound in icy fetters for about six months in the year, while at the same time New Brunswick would receive an additional impulse by St. Andrews being the port of exit for the productions of Canada. We certainly think that our neighbours of St. Andrews are entitled to great credit for the persevering manner in which they have, for a number of months past, directed their attention to the subject, both in having visited Quebec and causing a survey of the contemplated line of road to be made, and that, too, at their own expense. It is true, they have much to gain if it should go into successful operation; but at the same time, we must feel the benefits to be derived from it, for our interests are so intimately blended, that whatever affects the one must also be felt by the other."—*St. John's Courier, February* 25, 1836.

incorporating the "St. Andrews and Quebec Railroad Company," for the construction of a line from St. Andrews, New Brunswick, to Lower Canada.

Lord Glenelg was then Secretary of State for the Colonies, and it was to him the several resolutions of the Provincial Legislature, and the reports of what had then been done, were submitted. On the 27th of April an estimate of the cost of construction, and of the probable traffic, was also laid before him. The cost of the work was estimated at $4,000,000, and the revenue to be derived at $606,000, apart from the carriage of mails.*

The deputation urged the importance of an immediate survey on a more comprehensive scale than that of the previous explorations, and suggested that a sum not exceeding £10,000 be expended in an exploration through the wilderness country, an expenditure which would save thousands in the end; and as the service could not be completed in one season, that it should be commenced without delay. The deputation further proposed, as the means for raising the necessary capital, that the sum of £250,000 should be given as a bonus or special grant to the

* *Estimate of cost of construction.*

Grading 250 miles at $5,000 per mile (currency)..................£	812,500
Making the road and putting down rails for a single track, with turnouts, etc., at $7,000 per mile....	437,500
Whole estimated cost..........£	750,000
The association thought it safe to allow for contingencies, in addition thereto..................£	250,000
Total.......................£	1,000,000
Or, in sterling money..........£	888,889

Imports to Quebec.

West India produce.................£	5,000
European manufactures and merchandise.............................	10,000
Passengers, averaging 15 per day, 260 days, at 80 shillings each.........	15,600
Miscellaneous articles, equal to 50,000 barrels at 5 shillings each........	12,500
Emigrants, say....	5,000
Amount of imports...............£	48,100

Exports from Quebec.

Flour and provisions, say 110,000 barrels, at 3 shillings per barrel......£	16,500
Wheat, barley, oats, etc............	10,000
Staves, ashes and miscellaneous articles...........................	10,000
Passengers, as per contra...........	15,600
Amount from exports............£	52,100

To and from the intermediate country.

100,000 tons deals, timber, boards, and planks, at 7s. 6d. per ton....£	37,500
Shingles, staves, sawlogs, scantling, and other dimension lumber.....	7,500
Provisions, goods, passengers; *i. e.*, settlers and operators............	6,300
Total......................... ...£	51,300

Probable income.... ....£	151,500
Equal in sterling money to........£	134,666

Allowance for carrying mails and other items not included.

company on the principle established in the province for the construction of roads and internal improvements; that a further sum of £500,000 be invested in the stock of the company, the dividends to form a part of the casual revenues; the remaining £250,000 to be obtained in stock in the Canadas and New Brunswick.

On the 5th May, 1836, the deputation addressed a letter to Sir George Grey, then Under-Secretary of State, acknowledging the receipt of his letter of the 4th inst., which conveyed to them the gratifying information that their application for a sum of money not exceeding £10,000, to be expended in the exploration and survey of the proposed line of Railway from St. Andrews to Quebec, had been granted; and that the other propositions submitted by them would receive the attention of Government so soon as the result of the survey should be known. The deputation concluded their letter with an expression of thanks to Lord Glenelg.

The day after the arrival, from England, of the deputation at St. Andrews, 10th June, 1836, resolutions were passed at a public meeting to the effect—"that the munificent donation of £10,000 by His Majesty, "for the purpose of carrying into effect an exploration of the line for a "Railroad from St. Andrews to Quebec, affords an additional proof of "His Majesty's solicitude for the prosperity of his British North Ameri- "can Colonies, and is hailed by the members of the Association as an "earnest of the ultimate completion of the work." Sir Archibald Campbell was also thanked for the countenance and encouragement, he had given to the work.

The survey was entrusted to Captain Yule, who had a high reputation in the Royal Engineers for practical knowledge and professional ability, and upon the 24th July, 1836, that officer commenced the work at Point Levis.

The object was to ascertain whether the country was suitable for railway construction; also, to obtain such data as time would permit, in order to form an opinion as to the most eligible line. The scope of the examination was not confined to the project of connecting St.

Andrews and Quebec. It was extended to the wider question as to the benefits which the work would confer on the whole country. The survey followed the valley of the Etchemin River to Etchemin Lake, which had been previously examined by Captain Yule, and recommended for the route of the Levis and Kennebec Railway. From Lake Etchemin, the line of exploration was as straight as possible towards Mars Hill, and then direct to St. Andrews.

Between the upper part of the River St. John, nearest the Lake Etchemin and Mars Hill, several short lines were explored. Until that period, the country from east to west, was unknown. The only reports made of its character had been given by hunters who had passed in canoes along the St. John, the Allagash, or the Restook, and the general belief was that it was generally level; at least, without great inequalities.

In the exploration made by Captain Yule not a single feature, stream, lake nor mountain could be identified until the Restook was reached. There was neither map nor land-mark to assist the exploring party.

The survey showed several level tracts; but at other points the route was occasionally turned to the right or left by high hills and ridges. On the portion of the line between Mars Hill and St. Andrews, no important obstacles were found. The route, as a whole, was found to be remarkably free from such obstacles as might have been looked for in a large tract, of which part was believed to partake of a highland character; while there were few abrupt rocky ridges to lead to a deviation of the route from a direct course. But four large rivers, and a few broad and deep ravines were met. One unusual cause of expense was to be looked for, viz., the difficulty of obtaining supplies. The distance was estimated at 300 miles, and the cost of the line at one million pounds.

The scheme was favourably received by the Governor-General and by the great body of the people.

It was generally looked upon as promising extraordinary advan-

tages, and as a project which would give an impetus, never before experienced, to the prosperity of the country. On all sides it was held that every effort should be made to obtain an uninterrupted communication with the seaboard.

Moreover, the project was thought to be the commencement of a system of internal improvements to extend to the Far West, which had only to be put in operation to create an immense traffic and greatly to add to the wealth of the provinces. It was argued that this consideration should be kept prominently in view. The value of the export trade from the West, was inferred from the rivalry between New York and Pennsylvania in their endeavour to control it.

The people of the United States, moreover, appeared clearly to understand the advantages which would result to the British Provinces from the undertaking. Illustrations of the spirit in which the project was reviewed, can be found in the press of New York of that date.* These furnish an early indication that it was this project which suggested to parties in the United States the policy of claiming a portion of New Brunswick as a part of Maine, so that the proposed line could not be followed.

At that time the entire country through which Captain Yule prosecuted the surveys was held to be wholly within British territory.

* "A GREAT PROJECT.—The plan which the Canadians and the New Brunswick people, under the auspices of the British Government, have projected, of a railroad from Quebec to St. Andrews, in New Brunswick, or the City of St. John, so as to make, as it is said, St. Andrews a *wharf* and the Bay of Fundy a *harbour* for the St. Lawrence, is one of the most magnificent that has yet been projected upon this continent, and calculated to involve, ultimately, the most important political consequences. The idea was stolen from the Maine Legislature (!) where the project originally started; but Great Britain, with that sagacity and foresight that distinguish all her political movements, has taken it up and adopted it, and is likely, for want of sufficient enterprise in the Maine Legislature, not only to rob that State of the honour and the profit, but even of the *territory* over which it is absolutely necessary to construct the road: hence, undoubtedly, the reason why Sir Charles Vaughan, in his correspondence with our Government, relative to the North Eastern boundary, after the starting of the project, refused even to fall back upon the award of the King of Holland, as to the dividing line between Maine and the British Provinces, though he was very willing to adopt that line immediately after the award. The object of the British Government now is to secure enough of this disputed country to make a railroad upon, between the Bay of Fundy and Quebec.

It was in 1837 that the Government of the United States made objection to the route proposed, and Canada was then in rebellion. Were the troubles of that date too tempting an opportunity to be neglected? Had that outbreak not taken place, would the claim ever have been advanced?

It is true that in the treaty of 1783 the boundary was very vaguely described; but it was capable of arrangement. Unfortunately however, Canada, then weak, at war with herself, without cohesion, shaken by political difficulties, offered herself a willing prey to a strong and ambitious neighbour.

If the loss has been hers, the fault has, to no small extent, been hers also. The facts are now the history of the past, and there are few incidents of modern times which more plainly tell their lesson. Let us only hope that the lesson is not to be read in vain, and that those who follow us will profit by its teaching and will not again, by disunion and political discord, court spoliation, or dismemberment. The promoters of the Railway were, for the first time, made aware of the action of the United States Government, through the deputation of the association then in England. Upon their application for an interview with Lord Glenelg, the deputation received a despatch from Sir George Grey,* Under-Secretary of State, to the effect, that as the Government of the State

"This project we have called magnificent, not only on account of the undertaking itself, but on account of its high and weighty consequences. It enables the British Government to send all her troops, munitions of war, etc., with all possible speed, from that important naval position, Halifax, where the British Government is now fitting up one of the strongest fortifications in the world, to Quebec, Montreal, Toronto, the Lakes, and all along our northern and north-western territories. In five or six days, soldiers can be taken from the great military and naval depot at Halifax and put upon the St. Lawrence from Quebec to Ontario. The difficult and dangerous navigation of the St. Lawrence is thus avoided. The British will also thus have a port where their produce can be sent to and from the West Indies. Military and commercial advantages prompt the British Government to expend $4,000,000. for with the harbour of Halifax, as it is near Europe, a cordon of British bayonets can be made to surround us in the shortest possible time, and the produce of the Canadas, now seeking a mart in New York in American ships, can thus be turned to St. Andrews or St. John in British bottoms. But rely upon it, there is no question with a foreign power now so vastly invol-ing the future destinies of this country, as the disputed boundary line with England."

* 3d July, 1837.

of Maine had protested against the prosecution of the undertaking, on the ground that it involved an infringement of certain stipulations respecting the unsettled boundary question, the Governor-General of Canada and the Lieutenant-Governor of New Brunswick had been instructed to prevent further proceedings until measures had been taken to remove the objections of the State of Maine.

In pursuance of this interference, on the 24th of the same month, the secretary of the association received a communication from Sir John Harvey, Fredericton, to the effect that he had received the commands of His Majesty's Government, in consequence of a representation from that of the United States, peremptorily to prohibit any further proceedings for the construction of a railroad between St. Andrews and Quebec until the points in dispute should be settled. Captain Yule also wrote to the association on the sudden turn of affairs, adding a few words of sympathy and hope, and the proceedings of the association were abruptly closed.

An attempt was made in 1838 to revive the project, but the boundary question had then assumed grave importance, and nothing could be done.

The difficulties with Maine, which followed the sudden and unexpected suspension of the Railway survey, and the troubles connected with the rebellion in both Canadas, pointed to the fact that if Northern America was to remain British America, there must be a speedier connection between her and the Mother Country, and that in winter there must be a mode of approach to the Canadas other than the frozen St. Lawrence. The first indication that light had dawned in the Colonial office upon this subject, is found in a despatch from Lord Glenelg to Sir John Harvey,* to the effect that the Imperial Government had resolved to advertise for tenders for carrying the mails between England and Halifax by steam instead of sailing vessels; and that the Imperial Postmaster-General had turned his attention to the necessity of increased expedition in the carriage of mails by land.

* 24th Oct., 1838.

In a despatch dated 4th May, 1839, Lord Normanby informed Sir John Harvey that a contract had been entered into for a semi-monthly mail by steamships between Liverpool and Halifax, and the improvement of the mail roads was again earnestly pressed on the Colonial Governments.

It was, doubtless, the knowledge of the views of the Imperial Government, which led Lord Durham in his celebrated report to allude to the future of British America.

Some explanation has always been sought for his expressions at this date.* The words, it is true, are not many, but viewed in the light of our present knowledge they are pregnant with meaning. He says : "The "completion of any satisfactory communication between Halifax and "Quebec, would in fact produce relations between these Provinces "that would render a general union absolutely necessary." He was indeed more of a prophet than was believed for many years. In theory, the railway was undoubtedly the pivot of the Dominion, in fact, the railway owes its existence to the Dominion. In February, 1839, a body of armed men from the State of Maine attempted to take possession of the disputed territory. The organization of a force to repel the invasion must have established the necessity of a military road through the length and breadth of British America. These various difficulties led to a report from the post-office authorities at Quebec,* in which the road then used for carrying mails between Quebec and Fredericton is described as passing through the territory in dispute, and stating that in giving up this route there was but one other choice, "the neglected road partially opened by Sir James Kempt," between Metis on the Lower St. Lawrence and the River Restigouche.

The advantage of the Metis road, since known as the Kempt road, at that time was, that it passed through undisputed territory. From a military point of view it commended itself to the Government on the ground that troops and supplies could be brought by water from Halifax up the Restigouche to within 300 miles of Quebec, at periods when

* January, 1839.

the St. Lawrence is not practicable. An exploration and survey of a road from the Restigouche to the St. Lawrence was therefore made in the summer of 1839, and in the following year an appropriation was voted by the Imperial Parliament for the completion of this communication between Lower Canada and New Brunswick. It retained the name of its first projector, Sir James Kempt; for many years previous to 1839 it had fallen into disuse, and had almost become forgotten, but the dark and complicated aspect of affairs again brought it to notice, and led to its restoration.

* Quoted by Lord Normanby in despatch, May, 1839.

CHAPTER II.

THE BOUNDARY QUESTION, 1783 to 1842.

Final settlement of the Boundary Line disastrous to the Railway.—Treaty of Paris of 1783.—Disputed interpretations of that Treaty.—Subsequent Treaty of 1794.—The Commission under it.—St. Croix River named in the Treaty.—Doubtful Location of the "Highlands" of the Treaty.—The due North Line.—Verification of boundary of old Nova Scotia by ancient Letters Patent.—Featherstonhaugh and Mudge on original Grant.—Treaty of Ghent in 1814.—Blunders of the Commissioners.—Arbitration of the King of the Netherlands.—Award rejected by the United States.—President Andrew Jackson on the Question.—His reasonable proposals declined by the English Government.—A new survey organized by both Countries.—State of Maine overtly breaks International Law.—Lord Ashburton's Mission to Washington.—Daniel Webster.—The Boundary Line adopted prejudicial to Canada.

The Maine Boundary question, alluded to in the last chapter, was settled by Treaty in August, 1842; Lord Ashburton representing Great Britain, and the celebrated Daniel Webster the United States. It ceded to the United States much of New Brunswick Territory, including all that portion west of the River St. John through which Captain Yule had made the Railway survey in 1837. Thus its effect was almost to sever the geographical connection between the maritime Provinces and the Canadas.

One immediate consequence of this diplomatic sacrifice was the indefinite postponement of the Railway; and when a quarter of a century later, the period came for the construction of a line, the determination of its course was rendered a matter of the greatest possible difficulty.

It will be necessary to revert to the treaty of Paris of September, 1783, in order fully to understand this now almost forgotten difficulty, which at one time threatened serious complications.

It was set forth, that in order: "to forget all past misunderstand- "ings and differences that have unhappily interrupted the good corres- "pondence and friendship which they mutually wish to restore, and to "establish such a beneficial and satisfactory intercourse between the "two countries, upon the ground of reciprocal advantages and mutual "convenience, as may promote and secure to both perpetual peace and "harmony," * * * * "Article I. His Britannic Majesty acknowl- "edges the said United States, viz. New Hampshire, &c." * * * "Article II. And that all disputes which might arise in future on the sub- "ject of the boundaries of the said United States may be prevented, it is "hereby agreed and declared, that the following are and shall be their ".boundaries, viz.—from the Northwest angle of Nova Scotia, viz. that "angle which is formed by a line drawn due north, from the source of "St. Croix river to the highlands, along the said highlands which divide "those rivers that empty themselves into the St. Lawrence, from those "which fall into the Atlantic Ocean, to the Northwesternmost head of "Connecticut River; thence down along the middle of that river to "the forty-fifth degree of North latitude; from thence on a line due "West on that latitude, until it strikes the river Iroquois or Cataraquy; "thence along the middle of the said river into Lake Ontario; * * "* * * East, by a line to be drawn along the middle of the River "St. Croix, from its mouth in the Bay of Fundy, to its source; and "from its source directly North to the aforesaid highlands which divide "the rivers which fall into the Atlantic Ocean, from those which fall "into the river St. Lawrence; comprehending all islands within "twenty leagues of any part of the shores of the United States and "lying between lines to be drawn due East from the points where the "aforesaid boundaries between Nova Scotia on the one part, and East "Florida on the other, shall respectively touch the Bay of Fundy, and "the Atlantic Ocean; excepting such lands as now are, or heretofore "have been, within the limits of the said province of Nova Scotia."

There is every reason to believe that this description so far as it relates to the Maine boundary was sufficiently definite and intelligible

to the framers of the Treaty, and that its meaning was distinctly understood by them. Indeed there is nothing that the writer has seen which suggests that any doubt was felt at that time regarding it. Only a few years elapsed, however, when it was seen that the provisions of the Treaty contained the elements of dispute. It is not to be wondered at, therefore, when half a century had passed over, and another generation had to interpret them, that doubts were started by the new men who were then seeking political distinction. The old question assumed an entirely new form. Fresh claims were propounded. Difficulties, before unknown, were created; and the Boundary, notwithstanding repeated attempts at settlement, could not be defined to the satisfaction of both parties to the Treaty.

In 1784, immediately after the conclusion of the Treaty, a part of the ancient Province of Nova Scotia was converted into the Province of New Brunswick. English settlements were made at St. Andrews, and on the river Schoodic, believed to be the St. Croix of the Treaty. But even at this early period, some of the citizens of the United States were advancing the claim that the Magaguadavic was the true St. Croix. Other difficulties having occurred, a new treaty, called " The Treaty of Amity Commerce and Navigation," was made in 1794.

In the fifth article of this treaty after setting forth that doubts had arisen, as to what river was truly intended by the name of St. Croix, it provided that the question should be referred to the final decision of Commissioners, to be appointed as follows, viz: " One Commissioner shall " be named by His Majesty, and one by the President of the United States " by and with the advice and consent of the Senate thereof, and the said " two commissioners shall agree on the choice of a third; or if they can- " not so agree, they shall each propose one person, and of the two names so " proposed, one shall be drawn by lot in the presence of the two original " commissioners; and the three commissioners so appointed shall be " sworn impartially to examine and decide the said question according " to such evidence as shall respectively be laid before them. * * * * " The said commissioners shall, by a declaration under their hands and

"seals, decide what river is the river St. Croix intended by the Treaty "* * * * * and shall particularize the latitude and longitude of "its mouth and of its source, * * * * and both parties agree to "consider such decision as final and conclusive, so that the same shall "never thereafter be called into question, or made the subject of dispute "or difference between them."

These instructions are sufficiently simple and explicit, and acting upon them negotiations were commenced in 1796. By common agreement of the two nominated commissioners, a judge of the Supreme Court of New York, a man whose character stood high for talents and integrity, was appointed the third commissioner and umpire. Throughout the negotiations which continued until the autumn of 1798, it was strenuously insisted upon, on the part of the United States, that the Magaguadavic was the true St. Croix. This view was not accepted by the British commissioner. The result was that the third Commissioner decided that the British claim was fully established to the river Schoodic as the true River St. Croix of the Treaty of 1783. The river has two branches, one flowing from the West, the other from the North. Of these two branches, the western had been sometimes called the Schoodic, but the northern had been invariably called the Chiputnaticook. The commissioners recognized the western branch as the main stream. The source of the western branch of the Schoodic or true St. Croix, is some 50 miles distant from the source of the eastern branch or Chiputnaticook; the interval between the meridians of longitude of these two points is about 70 statute miles. Notwithstanding this decision that the western branch, the so called river Schoodic, was the river St. Croix of the Treaty of 1783, the commissioners proposed and decided that the Chiputnaticook, or eastern branch, should form the line of boundary; and in conformity with this decision they erected a boundary monument at its source. For what cause, or on what principle they arrived at this view is unintelligible. The duty of the commissioners was in reality limited to the determination of the geographical position of the river St. Croix, declared, by the Treaty of 1783, to be

the boundary of the two countries. In deciding that any other river should be the boundary they entirely overstepped their duty. It was indeed generally acknowledged that the commissioners had exceeded their powers, and in 1798 an explanatory article was added to the treaty of 1794, releasing the commissioners from their obligations to define the river St. Croix, and declaring that the decisions to which they had come should be permanently binding on England and the United States.

The establishment of the boundary at the source of the Chipütnaticook in place of that of the true St. Croix, was the first false step in these unfortunate negotiations. From this fatal error arose all the subsequent difficulties, which embarrassed the consideration of the question, and ultimately led to a settlement disastrous to the interests of Canada. It was also unfortunate that steps were not taken to define the entire boundary between the true starting-point on the St. Croix, and the succeeding governing point. Had this course been pursued, the true meaning and intent of the description given in the Treaty would have been apparent. Even had the labours of the Commissioners been extended to establish the boundary from their own starting-point, considerable light would have been thrown upon the subject. In all probability they would have discovered the mistake they had made, and as just and reasonable men, would have been led to rectify it. They contented themselves, however, in creating a starting-point not designed by the Treaty, and here their operations ceased. The main boundary still remained undefined. Had the ordinary principles which are followed in laying down the lines of a property, been applied, much confusion would have been avoided, and a boundary line traced, the substantial fairness of which would have been beyond impeachment.

Thirty-five years afterwards, the Government of the United States clearly enunciated the principles to be followed, through the Secretary of State, the Honorable Edward Livingstone. "Boundaries of tracts "and countries, where the region through which the line is to pass is "unexplored, are frequently designated by natural objects, the precise

[redacted]

of land on either north line, strictly agrees with the highlands described in the Treaty, viz:—"highlands which divide rivers that empty themselves into the river St. Lawrence, from those which fall into the Atlantic Ocean." Such are to be found, however, at the dividing ridge between the sources of the Penobscot and the Chaudière. At the sources of these rivers is to be found that point in the highlands nearest to the north line of the Treaty; accordingly such point presents itself as the natural object described in the Treaty of 1783. Between such point and the other known point, the source of the river St. Croix, a direct line drawn would have indicated the true boundary.

To the west of the dividing ridge, between the Penobscot and the Chaudière, the course of the highlands was easily defined to the Connecticut River, and thence along the 45th parallel of latitude to the westward; on this point there was no great difference of opinion.

It must never be lost sight of that in the Treaty description, the boundary is set forth as commencing at the Northwest angle of Nova Scotia, at the northern end of the direct line from the river St. Croix. It is, therefore, a matter of historical interest to examine how far the line drawn from the river St. Croix to the dividing ridge, at the source of the Chaudière, coincides with the boundary of the old province of Nova Scotia.

The first grant of Nova Scotia is contained in letters patent to William Alexander, Earl of Sterling, from King James 1st, in 1621, and confirmed by Charles 1st, in 1625.

The description of Nova Scotia, given in these letters patent, is as follows:—" Omnes et singulas terras continentis, ac insulas situatas et "jacentes in Americâ intra caput seu promontorium communiter *Cap* "*de Sable* appellat. Jacen. prope latitudinem quadraginta trium "graduum auteo circa ab equinoctiali lineâ, versus Septentrionem, a "quo promontorio versus littus maris tenden ad occidentem ad statio- "nem Sanctæ Mariæ navium vulgo *Sanctmareis Bay*. Et deinceps, "versus Septentrionem per directam lineam introitum sive ostium "magnæ illius stationis navium trajicien, quæ excurrit in terre orien-

"talem plagam inter regiones Suriquorum et Etcheminorum vulgo "*Suriquois* et *Etchemines* ad fluvium vulgo nomine *Sanctæ* "*Crucis* appellat. Et ad scaturiginem remotissimam sive fontem "ex occidentali parte ejusdem qui se primum predicto fluvio im- "mescet. Unde per imaginariam directam Lineam quæ pergere per "terram seu currere versus Septentrionem concipietur ad proximam "navium Stationem, fluvium vel Scaturiginem in magno fluvio de "Canada sese exonerantem. Et ab eo pergendo versus orientem per "maris oris littorales ejusdem fluvii de Canada ad fluvium stationem "navium portum aut littus communiter nomine de Gathepe vel Gaspee "notum et appellatum."

Translation of the text.

"All and singular the lands of the Continent, and Islands, situated and lying in "America, within the head or promontory commonly called Cape Sable, lying near the "north latitude of forty-three degrees, or thereabouts, from the equinoctial line; from "which promontory, towards (or along) the shore of the sea stretching to the west, to the "ships' station of St. Mary, commonly called St. Mary's Bay; and thence, towards the "north, by a direct line crossing over the entrance or mouth of that great ships' station "which extends inland into the eastern tract of country between the regions of the Suriqui "and Etchemines, commonly Suriquois and Etchemins, to the river commonly called by the "name of St. Croix; and to the most remote source or spring, from the western part of the "same, which first mingles itself with the said river; whence, by an imaginary direct line "which might be conceived to proceed through the country, or to run towards the north, to the "nearest ships' station, river, or spring, emptying itself in the great river of Canada; and "thence, by proceeding towards the East by the Gulf shores of the same river of Canada, "to the river, ships' station, port, or shore, commonly known and called by the name of "Gathepe or Gaspee."

The explanations of Messrs. Featherstonhaugh and Mudge, on the text of the original grant, establish that the original boundary line of Nova Scotia, from the mouth of the St. Croix to the source of the Chaudière, was the boundary line designed by the framers of the Treaty of 1783. In reality, the text of the Treaty is a repetition of the grant of 1621, and it could scarcely have been more precise, except with regard to the course of the imaginary straight line between the two natural objects, the source of the River St. Croix and the particular point in the highlands. The original grant runs:—"An imaginary direct line, which might be "conceived (concipietur) to proceed through the country or to run to- "wards the north."

A slight departure from this language was admitted into the Treaty, probably with a view to abbreviate the description, and hence the discrepancy. We have due north, instead of towards the north in a direct or straight line. Otherwise the two descriptions have one and the same meaning. The commissioners of the two Governments, however, decided on the point at the source of the Chiputnaticook as the starting-point; and they determined that this river should hereafter be considered the St. Croix—the *Sanctæ Crucis* of the Nova Scotia grant, which it undoubtedly was not.

The next step taken to effect a settlement of the boundary was in 1814, and the course determined on is fully set forth in the fifth Article of the Treaty of Ghent, viz:—

"Whereas neither that point of the highlands lying due north from "the source of the river St. Croix, designated in the former Treaty of "Peace between the two Powers as the North-west angle of Nova "Scotia, nor the northwesternmost head of the Connecticut River, have yet "been ascertained; and whereas that part of the boundary line between "the dominions of the two powers, which extends from the source of "the river St. Croix directly north to the above mentioned North-west "angle of Nova Scotia, thence along the said highlands which divide "those rivers that empty themselves into the river St. Lawrence from "those which fall into the Atlantic Ocean, to the northwesternmost head "of the Connecticut River, thence down along the middle of that river to "the 45th degree of North latitude, thence by a line due west in said "latitude, until it strikes the river Iroquois or Cataraqui, has not yet "been surveyed; it is agreed, that for these several purposes, two Com-"missioners shall be appointed, sworn, and authorized to act exactly in "the manner directed with respect to those mentioned in the next pre-"ceding Article, unless otherwise specified in the present article. The "said Commissioners shall meet at St. Andrews, in the Province of "New Brunswick, and shall have power to adjourn to such other place "or places as they shall think fit. The said Commissioners shall have "power to ascertain and determine the points above mentioned, in con-

"formity with the provisions of the said Treaty of Peace of 1783; and "shall cause the boundary aforesaid, from the source of the River St. "Croix to the River Iroquois or Cataraqui, to be surveyed and marked "according to the said provisions; the said Commissioners shall make "a map of the said boundary, and annex to it a declaration under their "hands and seals certifying it to be the true map of the said boun- "dary, and particularizing the latitude and longitude of the North- "west angle of Nova Scotia, of the north-westernmost head of the Con- "necticut River, and of such other points of the said boundary as "they may deem proper. And both parties agree to consider such "map and declaration as finally and conclusively fixing the said "boundary. And in the event of the two Commissioners differing, "or both or either of them refusing, declining, or wilfully omitting "to act, such reports, declarations, or statements shall be made by "them, or either of them, and such reference to a friendly Sovereign "or State shall be made, in all respects as in the latter part of the "fourth Article is contained, and in as full a manner as if the same "was herein repeated."

Had these Commissioners commenced at the source of the true St. Croix, that is to say, the main or western branch, and then extended a line due north, they would have reached highlands, at no great distance, where the waters flowing into the Atlantic take their rise. But the Commissioners began their labours at the point of commencement erroneously established by their predecessors at the source of the Chiputnaticook. Starting from this point, on a course due north, they passed through the opening in the highlands through which the River St. John finds a passage. The Commissioners in consequence found the wording of the Treaty in no way in accordance with the physical features of the country. The line run, not striking highlands, but passing through them at the opening through which the St. John flows, they encountered a wide intermediate expanse, and finally struck a second range of highlands at a point where the river Metis takes its rise. But the highlands divided the waters flowing into the Bay Chaleur,

from those flowing into the estuary of the St. Lawrence, and could not possibly be considered the highlands of the Treaty of 1783.

The Commissioners, under the Treaty of Ghent could not arrive at any decision. As a last resource, under its provisions, the question was referred by common consent to the King of the Netherlands for arbitrament, and the duty was accepted by that monarch. The subject was fully submitted to the arbitrator by the representatives of both Governments, with documentary evidence, and all that could throw light upon the case. It is believed, however, that the fact, that the western branch of the St. Croix had been set aside for the eastern branch, was not brought prominently forward. It may have been incidentally mentioned, but it was not adduced as a link in the evidence to explain much that was otherwise inexplicable. The boundary had in fact been declared to be settled in 1798, as far as the monument at the head of the Chiputnaticook could establish it, and although the selection of that stream was admitted to be a departure from the Treaty of 1783, it was held that this settlement precluded the reopening of the question.

The award of the King of the Netherlands was delivered at the Hague on the 10th of January, 1831. It was to the effect that the evidence submitted, and the vague and indefinite stipulations of the Treaty of 1783 did not permit an adjudication of either of the lines claimed by the respective Governments. The opinion was further expressed, that the original description of the boundaries of the British Provinces did not afford any basis for a decision ; that the instructions of Congress, when the Treaty of 1783 was being negotiated, placed the north-west angle of Nova Scotia at the source of the River St. John ; that according to Mitchell's map, (a document extant when the Treaty of 1783 was made and submitted in evidence,) the latitude of that angle was as far north as the banks of the St. Lawrence ; that according to the boundary of the Government of Quebec, it ought to be sought for at the highlands dividing the rivers which empty themselves into the River St. Lawrence from those which fall into the sea ; consequently, that the

"By the Treaty of 1783, the boundary between the dominions of "the two governments was to be a line drawn from the source of the "St. Croix, directly north, to the highlands which divide the rivers "which fall into the Atlantic Ocean from those which fall into the "River St. Lawrence; the point at which the due north line was to "cut the highlands, was also designated as the northwest angle of Nova "Scotia; thence along the said highlands to the northwesternmost "head of the Connecticut River, etc. The ascertainment of the true "northwest angle of Nova Scotia, or the designation of the highlands "referred to, has been the principal difficulty by which the settlement "of the boundary has been so long retarded; and it was the supposed "impracticability of satisfactorily accomplishing that ascertainment or "designation which prevented the adjustment by the Arbitrator. The "United States have always contended, that the point, to which they "have uniformly claimed, is upon certain highlands north of the river "St. John, which answers, in every respect, the description given in "the Treaty, and is the true northwest angle of Nova Scotia; a claim "which is not intended to be abandoned or weakened by anything the "President has authorized to be proposed or said upon the subject. If "the highlands now referred to, do in truth, answer the description, no "doubt could be reasonably entertained of the justice of our claim, as "there would be a perfect concurrence in the course prescribed, and "the natural object designated by the Treaty; but on the part of Great "Britain it has been strenuously contended, that no highlands, answer- "ing the description in the Treaty, could be found northward of the "river St. John, upon a line running directly north; and it has, there- "fore, been insisted that the due north line shall be deemed to ter- "minate to the southward of that river, and at a place called Mars "Hill. The President is advised, that it is a rule in practical survey- "ing, which prevailed in this country before the revolution, and has "since been, and still is considered obligatory, that when there is found "in the location of the premises described in a deed or any other instru- "ment, a disagreement in the course of a given line, and the bearing of

"a natural object called for, as its termination, the given course must "be made to yield to the given object, and the line closed at the object, "in a direction corresponding, as nearly as practicable, to the course "prescribed; upon the principle that the natural object furnishes evi- "dence of the true intention of the parties, which may be relied upon "with more safety than the course, errors in which constantly occur, "from the imperfections in the instruments used, or the want of knowl- "edge of those in whose hands they may have been placed. He has "thought that this rule might be rightfully and properly applied to the "matter now in controversy, and is willing to agree, that if, upon a "thorough examination, it shall appear to those appointed by the par- "ties to make it, that His Majesty's Government is correct in its assump- "tion, that the highlands hitherto claimed by the United States, as "those designated by the Treaty, do not answer that description, but "that those highlands are to be found to the west of the due north "line; that the boundary line should be closed according to the estab- "lished rule in practical surveying. Whether there are highlands to "be found in a northwesterly course from the source of the St. Croix, "answering better to the description given in the Treaty of 1783, than "those heretofore claimed by the United States, and so clearly identi- "fied as to remove all reasonable doubt, remains to be ascertained. No "inquiry into this fact, with a view to apply it to the respective and "conflicting pretensions of the parties, has hitherto been made. It was "under these circumstances, and with such impressions, that Mr. Liv- "ingstone was authorized to propose to Sir Charles R. Vaughan, for "the consideration of his Government, that a new commission should "be appointed, consisting of an equal number of commissioners, with "an umpire, selected by some friendly sovereign, from among the most "skilful men in Europe, to decide on all points in which they might "disagree; or a commission entirely composed of scientific Europeans, "selected by a friendly sovereign, to be attended in the survey and "examination of the country, by agents appointed by the parties. The "adoption of this course would, it was urged, have the benefit of strict

"impartiality in the Commissioners' local knowledge and high profes-"sional skill, which, though heretofore separately called into action, "have never before been combined for the solution of the question."

"In consequence of a wish expressed by Sir Charles R. Vaughan "to be more fully advised of the views of the President, upon the subject "of this proposition, he was furnished with a diagram, by which the "manner in which it was intended the line should be run, in the event "of highlands being discovered better answering the description of the "Treaty, than those claimed by the United States, was pointed out "distinctly; while to relieve His Majesty's Government from all ap-"prehension of a more extended claim of territory on our part, Mr. "Livingstone was authorized to disclaim and did disclaim, all pretensions "on the part of the United States, to the territory East of the line, "which had been previously run directly north from the source of the "St. Croix. * * *

"The President sincerely believes that the new process of investi-"gation, proposed by him, might under the control of the principle of "practical surveying developed, lead to a settlement of this agitating "question, which, as it would be legally and fairly made according to "a long established and well known rule, prevalent equally among the "citizens of the United States and the subjects of his Britannic Majesty; "ought to be, and he confidently trusted would be, satisfactory to all "parties."

The new principle of settlement, on the basis of the Treaty of 1783, embraced in the above extract, was made and urged by the Government of the United States for fully two years.*

Five despatches were written on the subject urging the fair, the honourable, and at the same time the practical solution of the question as recommended by President Jackson. They were forwarded to Lord Palmerston. A sixth dated April 28th, 1835, from Mr. Forsyth was

*April 30th and May 28th, 1833, from Mr. Livingstone to Sir C. R. Vaughan. June 5th, 1833, and March 11th and 21st, 1834, from Mr. McLane, Secretary of State, to Sir C. R. Vaughan.

despatched to the Duke of Wellington. The proposition made by the United States was not entertained, but a counter proposal was submitted by the Imperial Government, urging the expediency of agreeing upon a conventional boundary; a proceeding which would have necessitated a new treaty, amending the Treaty of 1783.

The United States Government had no authority to make a treaty without the concurrence of the Senate; moreover, it was even a question whether the treaty could be made without first obtaining the consent of the States, contiguous to the boundary. But the President had the constitutional authority to establish the line described in the Treaty of 1783, and in order to effect a speedy adjustment of a perplexing question, he felt justified in submitting the principle of settlement based on expediency and equity. At this day it is difficult to comprehend the reasons which induced the Imperial Government to reject the proposal of President Jackson; a mode of settlement frequently repeated, and which was presented on grounds supported by argument and sustained by practice. The proposal of the President removed all difficulty in the way of a speedy and satisfactory solution. The boundary, as far as the head of the minor branch of the St. Croix, had been agreed upon by both nations; and a monument had been erected as a fixed point of departure. It was now proposed and urged by the United States, to discard the due north line, to seek west of the due north line the undisputed "highlands which divide those rivers that empty themselves into the "river St. Lawrence, from those which fall into the Atlantic Ocean," to find the point in the "water shed" of these highlands nearest to the due north line, and to trace a direct course from it to the monument already established. If this principle had been adopted, a straight line would have been drawn from the monument at the head of the Chiputnaticook, to a point which could have been established with precision, in the "water shed" of the highlands which separate the sources of the Chaudière from those of the Penobscot; here being the most easterly point in the only highlands agreeing beyond dispute with the treaty. This point is found a little to the north and west of the

PLATE NO. 2.

Photo-Lith. by the Burland-Desbarats Lith. Co.

intersection of the 70th meridian west longitude and the 46th parallel of north latitude.

An examination of the map of the country, Plate No. 2, on which are depicted the water-sheds of the different drainage basins, will at once satisfy the reader that no other point could possibly be chosen. The water-shed which divides "those rivers that empty themselves into the river St. Lawrence from those which fall into the Atlantic Ocean," cannot be mistaken or disputed. The most easterly extremity of that water-shed is undoubtedly where the drainage basin of the Bay of Fundy begins. Here three water-sheds converge; namely, the water-shed between the river St. Lawrence and the Atlantic drainage systems; the water-shed between the river St. Lawrence and Bay of Fundy basins; and the water-shed between the Bay of Fundy and the Atlantic drainage systems. The point of convergence of these three water-sheds is the only point that could have been selected as the natural object sought for, had the proposal of President Jackson been acquiesced in.

That the proposal fell to the ground, must be attributed entirely to the fact that the Imperial Government declined to concur in it, unless cumbered with conditions which a President of the United States had no power to accept.

Occasional letters passed between the two Governments respecting a boundary to be established by convention, but no progress was made towards settlement. Indeed, little was done beyond an exchange of diplomatic correspondence, until the survey for the railway from St. Andrews to Quebec attracted attention. Representations were then made by the State of Maine to the Federal Government, to have the survey stopped. The following year, on the Government of the United States asking the concurrence of the State of Maine to enter into a treaty for a Conventional boundary line, the House of Representatives passed resolutions* affirming the inexpediency of entering into the negotiations,

*23d March, 1836, "Resolved, that it is not expedient to give the assent of this State to the Federal Government to treat with that of Great Britain, for a conventional

and insisting on the line established by the Treaty of 1783, and asking for the erection of fortifications to defend it.

In July, 1839, Colonel Mudge and Mr. Featherstonhaugh were appointed by the Imperial Government to survey the disputed territory, and to examine the several lines of boundary and the different ranges of highlands.

In April, 1840, they reported that there was a defined range of highlands lying between the sources of the rivers Chaudière and Du Loup flowing northward, and the Androscoggin and Kennebec flowing southward, and that it continued along the head waters of the Penobscot, which it divided from the waters of the St. John. These highlands were described as being capable of being traced across the river St. John and towards the head of the Bay Chaleur; they also reported that these highlands complied with the spirit of the Treaty of 1783—that no other highlands in the country to the north were found to answer the description; and that, to meet the want of such height of land, fictitious mountain ranges had been inserted in maps of some Surveyors of the United States. The Government of the United States, on their side, directed a survey to be made of the due north line, as far as the head of the river Metis on the high ground overlooking the St. Lawrence. In the mean time, an armed force from Maine entered upon and took possession of the disputed lands on the river St. John, and in the neighbourhood of the old established British settlement at Madawaska. They constructed forts and roads; their surveyors laid off lots of land, and sales were made with deeds regularly drawn up:—all under the authority of the State of Maine, and in direct contravention of the mutual agreements made by the United States General Government with the Imperial Government. Conflicts occurred between the settlers and the intruders; on one night the marauders burned down three home-

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"line for our northeastern boundary, but that this State will insist on the line established "by the Treaty of 1783."

"Resolved, that the Maritime frontier and the extensive interior position of this State are "in a defenceless and exposed position, and we rely with confidence that the Federal Govern-"ment will cause suitable fortifications to be erected for the defence of the same."

steads, destroying property of the value of $2500. Mr. Fairfield, who gave the name to the Fort on the Aroostook, was elected Governor a second time, by an immense majority, for the avowed purpose of taking possession of the disputed territory in accordance with his expressed determination. It was believed in the United States, that one chief motive with England was to preserve a direct mail route and military road between Halifax and Quebec, and it was equally a chief motive with many in the United States to stop that communication. The question became more and more perplexing. A voluminous correspondence passed between the Imperial Government, the Government of the United States, the Government of the State of Maine, and that of the Province of New Brunswick, but no progress was made towards a settlement; and so matters continued until 1842, when Lord Ashburton, under instructions from the Earl of Aberdeen, proceeded to Washington as plenipotentiary charged with full powers to negotiate and settle all matters in discussion between the United States and Great Britain.

Daniel Webster was the Secretary of State, and he at once commenced negotiations with Lord Ashburton for a conventional boundary.* Mr. Webster received the advice and assistance of four commissioners from the State of Maine. The result was the conclusion of the Ashburton Treaty.† The first article declared:—"That the line of "boundary shall be as follows:—Beginning at the monument at the "source of the river St. Croix, as designated and agreed to by the "Commissioners under the 5th Article of the Treaty of 1794, * * * * "thence north, following the exploring line run and marked by the "Surveyors of the two Governments in the years 1817 and 1818, * * "to its intersection with the river St. John, and to the middle of the "channel thereof; thence up the middle of the main channel of the said "river St. John to the mouth of the river St. Francis; thence up the "middle of the channel of the said river St. Francis and of the Lakes "through which it flows, to the outlet of the Lake Pohenagamook; "thence southwesterly in a straight line to a point on the northwest

* 17th June, 1842.

† Signed at Washington, 9th August, 1842

"branch of the river St. John, which point shall be ten miles distant "from the main branch of the St. John, in a straight line and in the "nearest direction; but if the said point shall be found to be less than "seven miles from the nearest point of the summit or crest of the high- "lands that divide those rivers which empty themselves into the river "St. Lawrence, from those which fall into the river St. John, then the "said point shall be made to recede down the said northwest branch of "the river St. John, to a point seven miles, in a straight line, from the "said summit or crest; thence in a straight line, in a course about "south, eight degrees west, to the point where the parallel of latitude "of 46° 25′ north, intersects the southwest branch of the St. John; "thence southerly by the said branch to the source thereof in the high- "lands at the Metjarmette Portage; thence down along the said high- "lands which divide the waters which empty themselves into the river "St. Lawrence, from those which fall into the Atlantic Ocean, to the "head of Hall's Stream; thence down the middle of said stream, till "the line thus run intersects the old line of boundary surveyed and "marked by Valentine and Collins previously to the year 1774, as the "45th degree of north latitude, and which has been known and under- "stood to be the line of actual division between the States of New York "and Vermont on one side, and the British Province of Canada on the "other; and from said point of intersection west along the said divid- "ing line, as heretofore known and understood, to the Iroquois or St. "Lawrence River." The Treaty farther declared the river St. John to be as free and open, from its source to its mouth in the Bay of Fundy, to the inhabitants of the State of Maine, as to the inhabitants of the Province of New Brunswick.

This ended the dispute. On the one hand, the United States accepted about five thousand square miles less territory than had been claimed for her on the plea that the line of boundary should extend on the due north line from the river St. Croix to the source of the river Metis on the crest of the dividing ridge between the river Restigouche and the lower St. Lawrence. It was argued that these were the high-

lands described in the treaty of 1783, as separating the waters falling into the Atlantic from the waters emptying into the river St. Lawrence :—a claim utterly untenable, as the highlands at the source of the Metis only separate waters falling into the Bay Chaleur from those flowing into the St. Lawrence, where it ceased to be a river; the St. Lawrence at that point being an estuary of the Gulf of St. Lawrence, scarcely less in width than Lake Ontario, and wider than the English Channel between Dover and Calais. On the other hand, the Imperial Government yielded an equal area of the territory which she had always persistently claimed, embracing the country watered by the river St. John, through which Captain Yule had made the survey for the railway between Quebec and St. Andrews, a country reported to be remarkably favourable for the construction of the projected Trunk line of Railway.

In reviewing the whole negotiations, it is evident that the first blunder on the part of those representing Great Britain, was made in 1797, in accepting as the boundary, the minor branch of the river St. Croix (the Chiputnaticook) instead of the main river; and by an addendum to the Treaty of 1794, declaring it the boundary as far as the monument, which had been erected at its source. Had the main river St. Croix been adhered to, as the Treaty of 1783 unquestionably intended, the true principles of settlement, those in fact which President Jackson so frequently urged for adoption, would inevitably have carried the line of boundary more than a hundred miles south of its present position, and would have preserved for the Dominion of Canada a territory measuring some eleven thousand square miles, equalling the combined areas of the states of Massachusetts and Connecticut; and which, from its geographical position, could not fail to be of the utmost value to the Dominion. When the location of the Intercolonial Railway is considered, the prejudicial effect of the Ashburton Treaty will be more generally understood.

CHAPTER III.

EARLY HISTORY CONTINUED

1842 TO 1852.

Military Road Surveyed.—Railway Mania of 1845 brings out the Halifax and Quebec scheme. — Sir Richard Broun advocates it. — The various routes. — Government of New Brunswick favours the route by Annapolis. — St. Andrews and Quebec Railway revived.—Lord Ashburton takes stock in it.—Ashburton treaty killed the scheme.—Halifax and Quebec routes to be surveyed.—Captain Pipon and Mr. Henderson appointed.—Major Robinson's report recommending Bay Chaleur route.—Mr. Wilkinson objects.—Construction of railway urged as a relief for the famine in Ireland. — Major Carmichael-Smyth's views.—Railway conference at Portland.—Nova Scotia sends Mr. Howe to England.—British Government objects to scheme.—Imperial proposals.—Negotiations upset.—Deputation to England.

THE settlement of the Boundary question did not lessen the necessity for a military road; indeed some line of communication for military purposes was the more necessary, as the new Boundary interposed a wedge of foreign territory which threatened to sever all connection between the Maritime Provinces and Quebec.

Accordingly, not long after the conclusion of the Treaty, the Imperial Government directed a survey of a military road to be undertaken, having in view the connection of the Provinces, at a distance as remote as practicable from the frontier. This survey was made by Col. Holloway of the Royal Engineers, aided by Sir James Alexander, then a Captain in the 14th Regiment. The latter was well and favourably known, acquainted with Canadian life, and strongly sympathizing with Canadian interests.

The route explored crossed the interior of New Brunswick from the bend of the river Petitcodiac, by Boiestown, Grand Falls, the north of Lake Temiscouata and Rivière du Loup to Quebec. It was

reported that lines of fortification were to be constructed to protect the road, and that a military post was to be established at the Grand Falls.

The survey was made in 1844. The reports set forth that in traversing the highlands, the most difficult grades would not exceed 1 in 15; that these could be reduced by oblique and prolonged circuits; that the bridging of streams would be attended with but little difficulty as the main rivers, St. John and Miramichi, were avoided; that the projected road would traverse a fertile, uncleared country, where there were abundant materials of wood and stone; and that the engineers estimated the cost at £2500 per mile for a macadamized road, and £450 per mile for a plank road subject to repairs in 5 years and renewal in 10 years. The total length of the road was estimated at 500 miles.

The year 1845 will be long memorable as that of the great railway mania in the United Kingdom. During this period many old projects were revived and many new ones started. Among the former was that of the St. Andrews and Quebec Railway, apparently recalled to life by the proposal of a new scheme, the Halifax and Quebec Railway, the prospectus of which had been issued in England.

At that time Sir Richard Broun was engaged in taking steps for the formation of a Colonization Company, under unusually favourable circumstances. The design was to combine the influence of all parties, on both sides of the Atlantic, who were interested in, or otherwise favourable to the revival of the rights of the Baronetage of Scotland and Nova Scotia. He was also engaged in schemes for connecting Great Britain with Japan, China and the East Indies, by means of a continuous line of steam navigation and railways through British North America. At this juncture he received a letter from a Mr. William Bridges, suggesting that a railway to unite the waters of the Atlantic and the St. Lawrence would be beneficial to the North American Provinces, and requesting his aid. It was readily promised, as the project so entirely agreed with his own theories.

Sir Richard Broun accordingly took an active part in the advancement of the scheme of the Halifax and Quebec Railway, and advocated it for years. In July, 1845, he forwarded to the Governors of New Brunswick and Nova Scotia a memorial from the Provisional Board praying for certain facilities and advantages on the plea that the proposed railway would supersede the necessity for the projected military road, and that it would furnish facilities for the systematic plantation and settlement of the whole frontier territory of British North America. The memorial was accompanied by a letter from Mr. Bridges, asking that the prayer of the memorialists should be recommended to the Home Government; and the memorial was forwarded.

Several routes were projected. One followed the line of the proposed military road from Halifax, by Truro, the Bend of the Peticodiac, Boiestown, Grand Falls and Temiscouata Lake. Another, joining the above line at Truro and starting from Canso. Another, starting from Halifax, crossing the Bay of Fundy between Annapolis and St. John, and then proceeding to Fredericton and Boiestown; and another, taking the last mentioned route to Fredericton, and proceeding up along the west side of the river St. John to Grand Falls.

The Governor of New Brunswick, in a despatch to the Home Government, stated, that having conferred with the Executive Council and several influential persons in Fredericton and St. John, there appeared to him a general disposition to co-operate with the Railway Association, particularly if the Association would declare its intention of adopting the route from Halifax, by Annapolis, St. John and Fredericton.

These proposals and negotiations revived the project of the St. Andrews and Quebec Railway, dormant since 1837. A meeting was held on the 8th October, 1845, at which a delegate was appointed to wait upon the Colonial Secretary and present a communication from the Association, in furtherance of the general interests of the undertaking. On the 24th of the same month, a special meeting of the Chamber of Commerce of St. John was held, when two delegates from St. Andrews were heard on behalf of the St. Andrews Railway, and resolutions were passed,

thanking the deputation for the information they had given, assuring them that the most eligible lines for the general good would necessarily command the most attention and consideration, regardless of local interests.

In November following, the Chamber of Commerce of St. John held another meeting and presented a report to the Governor, considering only the two routes from Halifax and giving their decided preference to that passing by Annapolis, St. John and Fredericton.

On the other hand, the people of St. Andrews continued their exertions in behalf of their own project. Subscription lists were opened, the capital asked for being £750,000 in shares of £25 each.

On the 25th November, 1846, a general meeting of the Stockholders was held, when a board of local directors was elected. Several shares were taken in England, and a London board was appointed, of which Mr. William Bridges, formerly of the Halifax and Quebec Railway, became Secretary. Lord Ashburton was a member of this board, and he courteously expressed his sympathy with the project.*

The settlement of the boundary question had placed St. Andrews at a great disadvantage. It could no longer obtain a direct connection with Quebec, without crossing territory which now formed part of the State of Maine. Thus the confident hope which the people of St. Andrews had formed with respect to their town becoming the ocean terminus of a great Intercolonial Railway, had passed away. It is true that a joint stock company, under the name of the St. Andrews and Canada Railway Co. after many struggles and difficulties suc-

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PICCADILLY, 25th June, 1847.

* "SIR,

"In reply to your note, I beg to say that I will take with pleasure a small interest "of (£500) five hundred pounds in the St. Andrews and Woodstock Railway Company. I "am geting too old for any extensive ventures of this or any other kind, but I feel so strong"ly interested in the settling of your fine Colony, that I am tempted to take this trifling in"vestment in a useful undertaking connected with it."

"I congratulate you on having Lord Fitzwilliam to place his name at the head of your "London subscribers. You could not possibly appear before the public more advantageous"ly than you are."

To Captain ROBINSON, R. N.

ceeded in constructing a railway as far as Woodstock, a distance of 94 miles ; but the Company has not been able to extend its works beyond that point.

In the mean time, the Halifax and Quebec scheme was experiencing many difficulties. The prospectus published in England had given the names of several men of standing and influence in Nova Scotia as connected with it. Several of these gentlemen repudiated the connection, stating that they never had been consulted and that their names had been used without their sanction. This proceeding destroyed confidence in the association. Nevertheless Lord Falkland, the Governor, looked upon the scheme as both practicable and desirable, and declared that he should deeply lament its being abandoned, either for want of effort to determine its feasibility, or from its having been undertaken by individuals without the influence to effect its completion. In view of the importance of the project, alike to the Mother Country and to the Colonies, he applied to the Home Government to send out competent Military or Civil Engineers to make an accurate survey, by which the practicability of the scheme could be determined and the best route established. He also set before the Home authorities that, as the mother country would obtain direct Railway communication with Quebec, the object proposed by the military road, it was hoped that the British Government would contribute towards the railway, some portion of the money which would otherwise have been expended on the military road.

Mr. Gladstone, then Secretary of State for the Colonies, replied to this despatch and approached with caution the question of granting any aid to the undertaking; but in April, 1846, instructions were issued to the Royal Engineers to make the survey asked for.

Public attention was much turned to the project by the speeches and writings of many prominent men who discussed it. The points generally considered were, the effect that the railway would have on the commerce of the country, on the settlement of wild lands, and on the union of the provinces into one community, the more intimate connection

which could be established with the mother country and the greater general security in case of war. On the last point, Col. Holloway, who had conducted the survey for the military road expressed himself strongly in favour of the Railway.*

Sir John Harvey in his opening address to the House of Legislature of Nova Scotia in January, 1847, recommended to their continued attention this railway, which he said was not second to any project which had ever engaged the notice of any Colonial Legislature in any part of the British Dominions, and which would:—"constitute the "most important link in that great line of communication, which may "be destined at no remote period to connect the Atlantic with the "Pacific Ocean, and to conduct to a British seaport, from those into "which it is now forced, that vast stream of trade, not of our own Western possessions alone, but of the rich and extensive wheat and grain "growing districts of all Central America."

Resolutions were passed by the Parliaments of the three Provinces, in Nova Scotia on 4th March, New Brunswick on the 2d April, and Canada on the 26th May, 1846, setting forth the necessity for the survey, and binding the several Provinces to make good the expense, each within its own limits.

Accordingly instructions for the survey were issued on the 11th June, 1846, by Mr. Gladstone, to Captain Pipon and Lieutenant Henderson of the Royal Engineers.

These instructions gave general directions for the line of survey: —viz. From Halifax to some port in the Bay of Fundy, whence by steamer connection would be made with St. John; starting again from St. John the line would proceed to Fredericton and along the valley of the river St. John to the Grand Falls; thence by the East side of

* 4th May, 1836.?

"I know that the British Government is strongly inclined for a military road, and if I "see no objection on further inquiry I would gladly recommend a railway instead of the "ordinary turnpike road. I believe the Government is impressed with the importance of a "railway from Quebec to Halifax in a political point of view, and I am of opinion that it is "highly desirable, if not absolutely essential, for the military defence of the British American Provinces."

Lake Temiscouata to the mouth of the river du Loup, and thence by the south bank of the river St. Lawrence to Quebec.

A second line was projected from Halifax to tne bend of the Petitcodiac, thence as straight to the Grand Falls as would be consistent with the best mechanical selection of the line, and from thence as before described to the St. Lawrence

A third line was projected from Halifax to the oend of the Petitcodiac, and thence keeping to the northwest by Newcastle and the Bay Chaleur, or its vicinity, to the St. Lawrence.

The survey was carried on by Capt. Pipon and Mr. Henaerson* until 28th October, 1846, when Capt. Pipon, in an attempt to save the life of a boy in his party, was drowned in the river Restigouche. The whole duty then devolved upon Mr. Henderson, until the summer of 1847, when Major Robinson of the Royal Engineers was appointed to take the place of Captain Pipon.

On the 1st May, 1847, Mr. Henderson made a preliminary report as far as the survey had then proceeded. He objected to the first route on four grounds. 1st, on account of the break in through communication, owing to the necessity of crossing the Bay of Fundy, 40 miles wide; 2d, from the probability that private enterprise would open up that section of the province; 3d, because in his opinion it was "evidently the object of the trunk line to benefit as much as possible "the mass of the Provinces," and 4th, because of very steep grades and heavy works to be found on that route.

On the second route he gave the preference to a line starting from Dartmouth, on the east side of Halifax harbour, because from that place, as a terminus, the railway would be five miles shorter than from Halifax.

The Cobequid Mountains were well explored, and the pass by Folly Lake pointed out. The survey by that time had reached the head waters of the river Restigouche, and showed that there would be difficulty and expense in crossing the river Tobique, a branch of the St. John, and that

* Now Col. Henderson

the construction of a railway by the line which had previously been selected for a military road was impracticable.

On the third route he endeavoured to find a line that would prevent the necessity of following the sea-shore along the Bay Chaleur, but it was not possible to find one. By the valley of the Nepissiguit, a practicable line was " out of the question," the hills becoming mountains separated by deep ravines, and at last " the mountains at the heads of the Tobique, Miramichi, etc., rise in wild confusion." He himself explored the greater portion ot the wilderness, in which lie the heads of the Tobique, Nepissiguit and Upsalquitch. On the whole he was forced to give his preference to the coast line by the Bay Chaleur.

Major Robinson made the final report of the survey under date of 31st August, 1848.

The route recommended was from Halifax to Truro, passing over the Cobequid Mountains, thence by the Gulf shore to the river Miramichi, which would be crossed at the head of tide, thence proceeding by the Nipissiguit River to the Bay Chaleur, and along the coast to the mouth of the Metapedia, proceeding up the valley of the Metapedia to the vicinity of the St. Lawrence, thence along the St. Lawrence to the Rivière du Loup and Point Levis.

The estimate for this line, for 635 miles, from Halifax to Quebec, was set down by Major Robinson at £7000 sterling per mile, or in round numbers £5,000,000 sterling, and it was strongly recommended that the railway, at whatever time it might be commenced, should be properly and efficiently constructed.

The route recommended would, in Major Robinson's opinion, secure the greatest immediate amount of remuneration for the expenditure, and the development in the highest degree of the commerce and fisheries of New Brunswick. The greatest facilities for construction were afforded, at many points, by its proximity to the sea, and, from the same cause, the least apprehension of interruption of traffic by climatic influences. Its remoteness from the United States frontier secured it from attack in case of hostilities with the United States, and the grades

would be easy on account of its passing through the least elevated country.

Major Robinson also urged, as additional reasons for the adoption of his route, and the speedy construction of the road:—

That by embarking and disembarking at Halifax, the danger and inconvenience from the navigation of the Gulf of St. Lawrence would be avoided.

That the mails to and from Canada would pass over territory exclusively British, and yet be received at Montreal as soon as they could be received at Boston.

That from a political and military point of view the proposed railway had become a work of necessity.

And that, if it should ever become necessary or advisable to unite all the British North American Provinces under one Legislative Government, the means to the end, the first step to its accomplishment, would be the construction of the Halifax and Quebec Railway.

In a letter of an earlier date he made mention of the difficulties attending the survey, and he spoke of the dangers and hardships which those engaged in the survey had experienced.*

Soon after the appearance of Major Robinson's report, Mr. Wilkinson, of the Crown Lands Office in Fredericton, who had been in charge of one of the surveying parties, published a pamphlet objecting to Major Robinson's recommendation of the Bay Chaleur route and his condemnation of the shorter and direct route through the centre of New Brunswick. Mr. Wilkinson contended that sufficient examination had not been made to establish the best line through the central district of New Brunswick, and that more explorations were desirable.

* He writes that one of his chief surveyors and draughtsmen, Mr. Grant, "in some burnt "land, having left the line for a short time to make a sketch from some rising ground, could "not again find the track, and after being lost for five days without a morsel of food, was "found on the morning of the sixth day lying exhausted, and at the last extremity, by some "lumbermen passing most providentially up the stream to which he had wandered, and "when unable to move farther he had laid down on the top of the bank for two days. This "solitary boat was, in all probability, the only one passing that way for a twelvemonth "together. Mr. Grant's hands and feet were frost-bitten, and though this happened early "in November, he has not yet (17th Dec., 1847) fully regained the use of them."

Major Robinson replied that large parties had been employed for two seasons on the central route, that officers of the Royal Engineers had explored the district for the military road, that he had made use of their reports, and that all information showed the improbability of discovering in that direction a practicable route for a railway. This discussion was continued until 1852.

In the mean time, a problem of more than usual difficulty occupied public attention:—colonization from Ireland, in consequence of the famine of 1847. It was contended that the Imperial Government should direct a systematized emigration to the British Colonies, with the certainty of obtaining employment for the emigrant on his arrival. The arguments mainly took the form of the scheme advocated by Sir Richard Broun, that colonization should be considered in connection with Railway construction. One gentleman, Mr. Buchanan, in a letter dated 12th February, 1847, to Lord Elgin, advocated the employment of 25,000 men on the Halifax and Quebec railway; to each of whom should be given 50 acres of land along the line of the railway, besides certain wages.*

Lord Grey, himself, favoured the grant of money to railways, instead of paying any direct subsidy to emigration, on the principle that emigration would follow the commencement of the railway. He considered that the hardships and difficulties, attendant on the new life of the emigrant, were to no small extent caused by want of combination, and by the absence of division of employment;—and in order that colonization might be best promoted, Parliamentary appropriations were required for carrying out desirable improvements, such as railways and canals, or other public works.

On the part of the local Governments, no effort was spared to induce the Home Government to intervene.

On the 31st March, 1849, an act was passed by the Legislature of

* Such a road he said, "as a great and national work, is admitted by every one connected with the colony, to be of the first and most vital importance, not only to the Colony, but to the Mother Country."

Nova Scotia, authorizing the transfer to the Imperial authorities of Crown Lands, ten miles wide, on each side of the line of the proposed railway, and pledging the House to the payment of £20,000 sterling, for interest on capital to carry on the work.

The Home Government, however, replied that the demands on the Imperial Treasury were, at that time, too manifold and too pressing to admit of any measure being submitted to Parliament for the aid required.

The project accordingly remained stationary; as the united resources of the three Provinces, unaided, were inadequate to carry on the work. But the question in no way passed out of view. It was discussed in the press. Several pamphlets appeared in its advocacy, among the latter a *brochure* by Major Carmichael-Smyth, appeared in the winter of 1849, earnestly setting forth the advantages of employing the people and capital of Great Britain in her own Colonies. This writer advocated the application of the surplus labour of the United Kingdom, to the construction, not only of an Intercolonial communication, but of an Imperial line of railway from Halifax to the Pacific coast.

The importance of a railway connection between Halifax and the United States system of Railways, was fully recognized in the United States, and an effort was early made to effect it. In July, 1850, a convention was called to meet at Portland, for the purpose of considering a series of propositions for the construction of a railway from Portland, through New Brunswick and Nova Scotia to Halifax. Representatives from the several British Provinces were invited to attend. At the meeting of this convention, the representatives of United States interests pledged themselves to construct their part of the railway through the State of Maine. Further, capitalists who were present professed their readiness to complete the whole railway through the British Provinces, provided Acts of Incorporation, with liberal grants of money and land, were given.

The representatives of the British Provinces, however, determined that they would construct the railway through their own territory with

their own resources. But as the rate of interest on loans would be reduced by an Imperial guarantee, another appeal was made to the Home Government to guarantee the interest on the cost of its construction; the revenue of the Provinces being pledged to the British Government as security.

The people of Nova Scotia were especially interested in the completion of this railway connection with Halifax, their capital. Mr. Howe, then premier, accordingly proceeded, as a delegate to England, to press their cause on the Home Government. He was so far successful, that he received a letter, 10th March, 1851, from the Colonial Secretary, to the effect that the Government had determined to recommend to Parliament that the guarantee should be granted, or that, the money should be advanced from the British Treasury, on certain conditions.

This letter made mention "of the strong sense entertained by the "British Government of the extreme importance, not only to the Colo-"nies directly interested, but to the Empire at large, of providing for "the construction of a railway, by which a line of communication may "be established, on British territory, between the Provinces of Nova "Scotia, New Brunswick, and Canada."

Mr. Howe's mission was to advocate the claims of Nova Scotia, in regard to the railway projected from Halifax to St. John, to meet a railway through the State of Maine from Portland. But the letter of the Colonial Secretary stated that the British Government would not feel justified in asking Parliament to pledge the credit of England for any object which was not of importance to the Empire as a whole. As they did not consider that the railway advocated by Mr. Howe answered this description, in order to obtain the Imperial guarantee it was essential that satisfactory arrangements should be made with Canada and New Brunswick, by which the construction of a railway, passing wholly through British territory from Halifax to Quebec or Montreal, should be provided for.

Moreover, in order that arrangements might be effected, the Im-

perial Government proposed to recommend to Parliament that Canada and New Brunswick should receive equal assistance. It was also determined, that the cost should be provided for by loans raised by the Provinces, with the Imperial guarantee; that the line recommended by Major Robinson, need not be followed, if a shorter and better line should be found, but that any deviation should be subject to the approval of the Imperial Government; that the loans to be raised in the several provinces should be a first charge upon the Provincial revenue, after payments on account of the civil lists; and also, that taxes should be imposed sufficient to provide for the payment of interest and sinking fund.

It was also stated, that the British Government would "by no "means object to its forming part of the plan which may be determined "upon, that it should include a provision for establishing a communi- "cation between the projected Railway and the Railways of the United "States."

At the same time (14th March, 1851), Earl Grey, Secretary of State for the Colonies, wrote to the Earl of Elgin, Governor General of Canada, that Her Majesty's Government had long earnestly desired to see the Railway constructed, as they considered it calculated greatly to advance the commercial and political interests both of the British Provinces in North America and of the Mother Country; and that they regarded the work as of so much importance to the whole Empire as to justify them in recommending to Parliament that Imperial assistance should be given. Earl Grey concluded by suggesting that a deputation from the Executive Councils of Nova Scotia and New Brunswick, should meet Lord Elgin and his Council, for the purpose of coming to some agreement on the different matters to be considered in connection with the Railway; which agreement, after being approved by the Legislatures of the several Provinces, might be submitted for the sanction of the Imperial Parliament.

The suggested conference was held at Toronto, and a satisfactory arrangement attained. The Parliament of Canada, being then in ses-

sion, proceeded without delay to the required legislation. The Assemblies of the Maritime Provinces were called expressly for the purpose, but before the Legislature of New Brunswick could meet, a despatch was received from London conveying the intelligence that, although the British Government had no objection to the project including a proviso for establishing a communication with the Railways of the United States, the cost of such a communication could not be included in the guarantee.

Mr. Howe had understood that the guarantee would cover the cost of the Railway advocated by him in London, namely, from Halifax, by Truro and St. John, to join the Railways from Portland in the United States, as well as of the main line to Quebec and Montreal. As this Railway (the European and North American Railway) was considered to be of very great importance to New Brunswick, and as the Legislature of that Province had already pledged the public credit to the extent of £300,000 sterling for that line and the St. Andrews and Quebec Railway, it was not considered expedient to accept the terms offered if that line was not included in the guarantee.

The conference therefore came to an end; but the delegates before separating expressed their determination not to abandon the hope of obtaining the desired aid from the Imperial Government. Accordingly Sir Francis Hincks, Mr. E. B. Chandler and Mr. Howe proceeded to London and pressed their views on the Government of which Lord Derby was then the head.

Although the various despatches show that the Imperial Government, under different administrations, always held that the proposed Railway from Halifax to Quebec would be of benefit to the Mother Country, the terms conceded to Mr. Howe by the letter of the 10th March, 1851, required that the Railway should be constructed at the cost of the Provinces; and that the Provinces should tax themselves sufficiently to secure the Mother Country from loss by the guarantee of interest. The assistance offered by the Imperial Government was limited to the guarantee of a loan, by which the yearly interest would

be reduced. It therefore followed, that the deputation should consider what would be most advantageous to the Provinces. They urged that Major Robinson recommended this route principally on military considerations, treating revenue as of secondary importance, as his line avoided the populous districts of New Brunswick ; that, on account of the settlement of recent difficulties with the United States, military considerations need no longer assume such prominence, and no special necessity continued for keeping the railway far oft from the frontier of the United States; consequently, that the proposed line should pass by St. John and up the valley of the river St. John, as that route promised the greatest commercial advantages. It was further argued, that as the whole cost of construction would be borne by the Provinces, the Colonial Legislatures could scarcely be expected to sanction a line with the primary view of consulting military or Imperial interests.

Lord Derby acknowledged the force of the arguments, and admitted the importance of a Railway through British territory, connecting the Provinces. He however declined to extend aid on the terms proposed.

CHAPTER IV.

HISTORY CONTINUED.

1852 TO 1862.

The provinces build railways on their own resources.—Another unsuccessful appeal to the Home Government.—Civil war in United States.—Provinces again appeal.—Resolutions of Quebec in 1861.—Effect of "the Trent affair."—Provinces ask for modified assistance. —Failure of negotiations.

No further communications on the subject appear to have passed between the several Governments, from 1852 to 1857, with the exception of a statement furnished by the Imperial authorities in April, 1856, showing that the surveys had cost £14,605.17.10 sterling, with a request to the three Provinces to repay the balance owing by them, £1449.17.4 sterling.

The three Provinces, however, without any unity of plan, but each acting independently, determined each with its own resources to proceed with the construction of railways.

The Intercolonial system accordingly was commenced at different points, on no defined plan, and on no assured certainty when the full system would be completed.

In 1852, Canada incorporated the Grand Trunk Railway Company with the Provincial guarantee of $12,000 per mile, for the construction of the line from Sarnia to Trois Pistoles, 153 miles east of Quebec. The section to St. Thomas, 41 miles, was finished in 1855, to River du Loup, about 120 miles from Quebec, in 1860. The line was not continued to Trois Pistoles as originally intended, and River du Loup accordingly became the terminus of the Grand Trunk Railway.

In September, 1852, New Brunswick entered into a contract with Messrs. Peto, Betts, Jackson and Brassey, for the construction of the

railway from the western side of the Province, easterly to the boundary line between New Brunswick and Nova Scotia. By September, 1853, the surveys were so far completed that the first sod was turned on the 14th of that month. Construction was immediately commenced, and was prosecuted until 1854. But the financial crisis, consequent upon the Crimean war, brought the operations to a close.

In 1856, the contractors retired from the work, and the portions of the line on which their operations had been carried on, lying chiefly between Moncton and Shediac, were transferred to the Provincial Government. Operations were at once undertaken by the Government. The railway was opened for traffic in 1860, between St. John and Shediac, a distance of 108 miles.

In the spring of 1854, Nova Scotia passed the Railway Act, authorizing a Provincial loan. The first sod was turned at Richmond, near Halifax, on the 13th June, 1854. The railway was opened for public traffic to Truro, 61 miles, on the 15th December, 1858.

Thus between Quebec and Halifax, 288 miles of railway were independently built by the three Provinces, without aid from the Imperial Government. In June, 1857, negotiations were resumed, and a deputation left Canada in July, to submit to the Imperial Government the political considerations which suggested that aid should be granted to the enterprise. The Imperial executive, however, declined to apply to Parliament for the aid asked for, on the ground that the resources of the Empire were already severely taxed.

The following year, pursuant to mutual agreement, each Province sent an address to the Queen, setting forth that each Legislature was prepared to aid the railway to the full extent of the resources of the country, and that they would regard no sacrifice too great to promote its construction.

On the 1st May, 1858, the Legislature of Nova Scotia addressed Her Majesty, to the effect that this enterprise, of more than colonial importance, had been pressed upon the consideration of Her Majesty's Government for many years, that the benefits to be derived were ac-

knowledged, but that, as the accomplishment was beyond their unaided resources, the result must depend on the assistance which would be given it.

In the same year the Legislature of Canada, passed a series of resolutions * setting forth, that the national importance of the scheme called for the interference of the Government, that during the months of winter, intercourse between the Provinces could only be carried on through the United States; that in time of war, the difficulty of access to the ocean would be seriously felt; and arguing that the railway, while extending facility of communication from Province to Province, was necessary for Imperial interests, and would form an important section of a highway which would ultimately extend across British America from the Atlantic to the Pacific.

Each Province also sent delegates to London again, to press upon the Imperial Government the object so earnestly desired; but only to meet with another denial, the negative being clothed in the official

* 1. That the construction of an Intercolonial Railway, connecting the Provinces of New Brunswick, and Nova Scotia with Canada, has long been regarded as a matter of national concern, and ought earnestly to be pressed on the consideration of the Imperial Government.

2. That during several months of the year, intercourse between the United Kingdom and Canada, can only be carried on through the territory of the United States of America, and that such dependence on and exclusive relations with a foreign country cannot, even in time of peace, but exercise an important and unwholesome influence on the status of Canada, as a portion of the Empire, and may tend to establish elsewhere that identity of interest, which ought to exist between the Mother Country and her Colonies.

3. That while the House implicitly relies on the repeated assurance of the Imperial Government, that the strength of the Empire would be put forth to secure this Province against external aggression, it is convinced that such strength cannot be sufficiently exerted during a large portion of the year, from the absence of sufficient means of communication; and that should the amicable relations which at present so happily exist between Great Britain and the United States be ever disturbed, the difficulty of access to the Ocean during the winter months might seriously endanger the safety of the Province.

4. That in view of the speedy opening up of the territories now occupied by the Hudson Bay Company, and of the development and settlement of the vast regions between Canada and the Pacific Ocean, it is essential to the interests of the Empire at large, that a highway extending from the Atlantic Ocean westward should exist, which should at once place the whole British possessions in America, within the ready access and easy protection of Great Britain, whilst, by the facilities for internal communication thus afforded, the prosperity of those great dependencies would be promoted, their strength consolidated and added to the strength of the Empire, and their permanent union with the Mother Country secured.

phraseology which the practised pen of the Colonial Office can so well use. While those who were advocating the project saw that in the future the federation of British North America must follow, the Colonial Office considered that the opportune moment had not arrived; that national expenditure must yield to national resources; and however important the benefits which the Intercolonial Railway would confer, objects of interest to Great Britain yet more urgent had presented themselves, and that the project must yield to the necessity of not unduly increasing the public burthens.

In 1861 the civil war was raging in the United States. Again the necessity of the railway became so evident that it could not be ignored; and it was felt that under the pressure of events another appeal should be made for Imperial assistance. An address was presented to the Queen in April, repeating the arguments so frequently and so unsuccessfully advanced. But there was the same reply, that it was not possible to encourage expectation of assistance. The provinces, however, still adhered to their determination in no way to abandon the enterprise, and in October, 1861, a despatch was sent to the Imperial Government, conveying the Resolutions agreed to by fifteen delegates from the several Provinces, met in council at Quebec.

These resolutions were to the effect that the Government of the Provinces should renew the offers of October, 1858, to the Imperial Government, to aid in the construction of a railway to connect Halifax with Quebec, and that a delegation from each Province should proceed to England, with the object of pressing the project upon the Home Government. At the same time that the Provinces should endeavour to procure the separate provincial legislation necessary to carry out the project, and that the route should be decided by the Imperial Government.

The delegates * proceeded to England and, while they were engaged in submitting their propositions to the Colonial Secretary, news of

* Hon. P. M. Vankonghnet for Canada, Hon. Joseph Howe for Nova Scotia, and Hon. S. L. Tilley for New Brunswick.

what is known as "the Trent affair," reached England. This event placed the enterprise in such a light before the British public, that the success of their application seemed assured.

The delegates themselves put forward their case with great force, stating that the late startling events rendered their representations almost superfluous. The war against which they had desired security was now imminent. Their frontier was unprotected, and exposed to the concentration of hostile troops at the termini of seven railways of the United States. A hundred thousand men, they said, could be sent across the frontier with more ease than a single battery of artillery could be transported from England, or a single barrel of flour carried to the sea-board. In their present position, if cut off by war from the United States and by the winter ice from Canada, the Maritime Provinces would have to depend upon Europe for their breadstuffs. The delegates added, that, if the facts which had occurred, and the dangers which were apprehended did not successfully plead their cause, all that they could advance would only be a needless intrusion on the patience of the Government.

The terms which the delegates at this time proposed were different from those previously submitted. The estimate for the railway, required to be constructed, was £3,000,000 Sterling, and the delegates proposed that in order to meet the yearly interest on this sum at four per cent., the provinces would raise yearly £60,000, if the Imperial Government would raise the other £60,000 yearly; in consideration of which, mails, troops, and munitions of war on Imperial account, were to be carried free. This proposal the Imperial Government declined to accept, but renewed the offer of Lord Grey, of the 10th March, 1851.

On the 10th March, 1862, delegates from all the provinces met again in Quebec to consider the renewed proposal of the Imperial Government; and they came to the resolution to accept the proposal of the Imperial guarantee of interest on the loans to be made.

Influenced by the conviction of the paramount importance of the railway as forming an essential link in a line through British territory, from the Atlantic to the Pacific, the Provinces resolved themselves to

assume the liabilities necessary to its construction. Delegates were accordingly appointed to proceed to England * to arrange the terms on which loans could be made, and the extent of the security to be given, as well as the amounts to be allowed for the transport of troops and mails, and indeed generally to determine the best mode of commencing the enterprise. Several interviews took place between the members of the Home Government and the delegates. The rate of interest, the terms of re-payment, and the question of the priority of the Imperial obligation over the other debts of the provinces, were all severally discussed, likewise the establishment of a sinking fund, which the delegates did not favour. The delegates from New Brunswick and Nova Scotia did not recognize that serious difficulty was involved in this last condition, and therefore to meet their legislative duties, they left London before the termination of the negotiations. The delegates from Canada, however, had formed strong objections to the establishment of a sinking fund; they therefore prepared a memorandum dated December 23rd, 1862, on this point, setting forth, that the conditions proposed by the delegates, and detailed in a paper submitted,† would enable the Colonies to borrow the requisite funds at the low rate of 3½ per cent., and would render the Imperial guarantee a real act of assistance: one which would be

* Hon. W. P. Howland and Hon. J. B. Sicotte for Canada; Hon. Joseph Howe for Nova Scotia, and Hon. S. L. Tilley for New Brunswick.

† CONDITIONS PROPOSED BY THE DELEGATES.

"1. That the loan shall be for £3,000,000 Sterling.

"2. That the liabilities of each Colony shall be apportioned as follows:—

£1,250,000 for Canada.
875,000 for New Brunswick.
875,000 for Nova Scotia.

"3. That the debentures shall bear interest at the rate of 3½ per cent.

"4. That the interest shall be paid half yearly in London, on the 1st day of May; and the 1st day of November.

"5. That the loan shall be repaid in four instalments.

£ 250,000 in 10 years.
500,000 in 20 years.
1,000,000 in 30 years.
1,250,000 in 40 years.

accepted as an equivalent to a contribution by the Imperial Government to the undertaking. The memorandum further set forth that the resources of the provinces were in themselves an ample security against any loss falling on the Imperial exchequer.

This memorandum was forwarded to the Colonial Office, but no farther interview consequent upon it was held. Their colleagues having left for Nova Scotia and New Brunswick, the Canadian delegates themselves returned to their own Province.

"6. That the net profits of the road shall be applied towards the extinction of the loan.

"7. That the loan shall be the first charge upon the revenue of each Colony, after the existing debts and charges.

"8. That the Imperial Government shall have the right to select one of the Engineers appointed to make the surveys for the location of the line.

"9. That the selection of the line shall rest with the Imperial Government.

"10. If it is concluded that the work is to be constructed by a joint Commission, it "shall be constituted in the following proportions: Canada shall appoint two of the Commis- "sioners, New Brunswick and Nova Scotia each one. These four shall name a fifth before "entering upon the discharge of their duties.

"Such portions of the railways now owned by the Governments of Nova Scotia, and " New Brunswick which may be required to form part of the Intercolonial road, will be " worked under the above Commission.

"12. All net gain or loss resulting from the working and keeping in repair of any "portion of the roads constructed by Nova Scotia and New Brunswick and to be used as a "part of the Intercolonial road, shall be received and borne by these Provinces respectively; "and the surplus, if any, after the payment of interest, shall go in abatement of interest on the "whole line between Halifax and Rivière du Loup.

"13. That the rates shall be uniform over each respective portion of the road.

"14. That Crown Lands required for the Railway or Stations shall be provided by each Province."

CONDITIONS PROPOSED ON THE PART OF THE IMPERIAL GOVERNMENT.

"1. That Bills shall be immediately submitted to the Legislatures of Canada, Nova Scotia, and New Brunswick, authorizing the respective Governments to borrow £3,000,000, under the guarantee of the British Government, in the following proportions :—five-twelfths Canada, three and one-half twelfths, Nova Scotia, and three and one-half twelfths, New Brunswick.

"2. But no such loan to be contracted on behalf of any one Colony, until corresponding powers have been given to the Governments of the other two Colonies concerned, nor unless the Imperial Government shall guarantee payment of interest on such loan until repaid.

"3. The money to be applied to the completion of a railway connecting Halifax with Quebec, on a line to be approved by the Impêrial Government.

"4. The interest to be a first charge on the consolidated revenue funds of the different provinces, after the civil list and the interest of existing debts, and as regards Canada, after the rest of the six charges enumerated in the 5 and 6 Vic., cap. 118, and 3 and 4 Vic., cap. 35 (Acts of Union.)

"5. The debentures to be in series as follows, viz.:

£ 250,000	to be payable	10 years	after contracting loan.
500,000	"	20	"
1,000,000	"	30	"
1,250,000	"	40	"

"In the event of these debentures, or any of them, not being redeemed by the Colonies at the period when they fall due, the amount unpaid shall become a charge on their respective revenues, next after the loan, until paid. The principal to be repaid as follows:—

1st. Decade (say 1868 to 1872, inclusive). £250,000 in redemption of the 1st series, at or before the close of the 1st decade from the contracting of the loan.

"2nd. Decade (say 1873 to 1882, inclusive.) A sinking fund of £40,000, to be remitted annually; being an amount adequate, if invested at 5 per cent. compound interest, to provide £500,000, at the end of the Decade: the sum to be remitted annually, to be invested in the names of Trustees in Colonial Securities of any of the three Provinces, prior to, or forming part of the loan now to be raised, or in such other colonial Securities as Her Majesty's Government shall direct, and the then Colonial Government approve.

3rd. Decade (say 1883 to 1892, inclusive). A sinking fund of £80,000, to be remitted annually; being an amount adequate, if invested at 5 per cent. compound interest, to provide £1,000,000 at the end of the decade: the amount, when remitted, to be invested, as in the case of the sinking fund for the preceding decade.

"4th. Decade (say 1893 to 1902, inclusive). A sinking fund of £100,000, to be remitted annually; being an amount adequate, if invested at 5 per cent. compound interest, to provide £1,250,000, being the balance of the loan, at the end of the decade. This amount, when remitted, to be invested as in the preceding decade.

"Should the sinking fund of any decade produce a surplus, it will go to the credit of the next decade. And in the last decade the sinking fund will be remitted or reduced accordingly.

"It is, of course, understood, that the assent of the Treasury to these arrangements, presupposes adequate proof of the sufficiency of the Colonial revenues to meet the charges intended to be imposed upon them.

"6. The construction of the railway to be conducted by five commissioners. Two to be appointed by Canada, one by Nova Scotia, and one by New Brunswick. These four to choose the remaining commissioner.

"7. The preliminary surveys to be effected at the expense of the Colonies, by three engineers, or other officers nominated, two by the commissioners, and one by the Home Government.

"8. Fitting provision to be made for carriage of troops, etc.

"9. Parliament not to be asked for this guarantee until the line and surveys shall have been submitted to and approved of by Her Majesty's Government, and until it shall have been shown, to the satisfaction of Her Majesty's Government, that the line can be constructed without further application for an Imperial guarantee."

CANADA, NEW BRUNSWICK, AND NOVA SCOTIA INTERCOLONIAL RAILWAY LOAN.

Canada.	*First Decade*	*Second Decade.*	*Third Decade.*	*Fourth Decade.*
To pay annually for interest............	£ 50,000	£ 45,833⅓	£ 37,500	£ 20,833⅓
At the end of the first ten years, a principal sum of........................	104,583⅓	....	....	....
And after the first ten years a sinking fund per annum.....................	....	16,666⅔	33,333⅓	41,666⅔
Per annum	50,000	62,500	70,833⅓	62,500
And at the end of the first ten years a principal sum of.....................	104,583⅓	....	....	....
New Brunswick				
To pay annually for interest............	35,000	32,083⅓	26,250	14,583⅓
At the end of the first ten years a principal sum of..........................	72,708⅓	....	....	....
And after the first ten years a sinking fund per annum.....................	....	11,666⅔	23,333⅓	29,166⅔
Per annum............................	35,000	43,750	49,583⅓	43,750
And at the end of the first ten years a principal sum of	72,708⅓	....	....	....
Nova Scotia.				
To pay annually for interest............	35,000	32,083⅓	26,250	14,583⅓
At the end of the first ten years a principal sum of..........................	72,708⅓	....	....	....
After the first ten years a sinking fund per annum..........................	....	11,666⅔	23,333⅓	29,166⅔
Per annum............................	35,000	43,750	49,583⅓	43,750
And at the end of the first ten years a principal sum of	72,708⅓	....	....	....

CHAPTER V.

HISTORY CONTINUED.

1862—1867.

State of railway extension in 1862—New Brunswick and Nova Scotia make fresh efforts—Survey determined on—Mr. Sandford Fleming appointed—Mr. Fleming's report—Advantages of the Bay Chaleur route—Newfoundland railway—Political dead-lock in Canada—Movement towards Confederation—Members of Canadian Legislature invited to Maritime Provinces—Convention at Charlottetown—The Quebec Convention—Resolution respecting Intercolonial Railway—General festivities—Act of Confederation—Act guaranteeing interest on Railway loan.

At the close of the decade ending 1862, the Railway system had been extended through a considerable portion of British America. The Grand Trunk Railway was in operation from Sarnia, at the foot of Lake Huron, to Rivière du Loup a hundred and twenty miles from Quebec towards Halifax; a distance in all of 780 miles. A Railway had been constructed from St. John to Shediac in New Brunswick one hundred and eight miles in length. Halifax had been similarly connected with Truro in Nova Scotia, by a line sixty miles in length; and towards the close of 1862 a well directed effort had been made to establish the conditions on which the Imperial Government would assist in the completion of the line yet to be constructed. Although this attempt did not succeed, the hope was still entertained that the difficulties experienced could eventually be removed, if a spirit of concession and good feeling actuated all who were conducting the negotiations.

The action of the Canadian delegates with regard to the sinking fund, led to some disappointment in the Maritime Provinces. The conditions had been fully discussed in repeated conferences, and changes

had been introduced to meet the objections that had from time to time been offered. It was considered, therefore, that possibly the Imperial Government might have been induced to modify the objections which it had advanced, if met by argument and conciliation.

The Secretary of State for the Colonies in a despatch to the Governor-General of Canada, January 17, 1863, stated that he certainly had been under the impression that, with the exception of the establishing of a sinking fund, all the difficulties had been removed by explanation or concession; that the objections to a sinking fund had been to a great extent removed; and that he thought some of the grounds set forth in the memorandum of the Canadian delegates would hardly have been advanced if the objectors had thought it advisable to ascertain by further conference the intentions of Her Majesty's Government.

The Legislatures of New Brunswick and Nova Scotia in no way remitted their efforts, they still put forth their old energy and continued that unflinching support and determination, which had gone so far towards attaining success. On the return of the delegates, bills were passed authorizing loans for the construction of the railway. The votes were carried with the expectation that the Government of Canada would take the same course. But it was held in that Province that the failure of the negotiations left matters precisely where they had been, and that there was no call for legislation inasmuch as no defined policy had been determined.

On the 25th February, 1863, an Order in Council was passed by the Canadian Executive; it expressed concurrence in the action taken by their delegates and suggested a course of action which in their view would, more speedily than any other, arrive at a practical and definite settlement.

In the recent negotiations in London, the Home Government had insisted that the Imperial Parliament should not be asked to guarantee the loan of £3,000,000, until the surveys had been made, the line submitted to and approved by Her Majesty's Government, and until it had been satisfactorily shown that the railway could be put in operation

without further application for an Imperial guarantee. It was further asked that the survey should be carried on by three engineers, one of whom was to be appointed by the Home Government.

Accordingly the Canadian Government considered that a reliable survey and estimate should precede any further negotiations with respect to ways and means.

A sum was therefore placed in the estimates for that purpose and it was arranged that the duty should be performed by a commission of three Engineers, one appointed by the Province of Canada, one jointly by Nova Scotia and New Brunswick, and the third by the Imperial Government.

In pursuance of this arrangement the Government of Canada passed an order in Council on the 22nd August, 1863, appointing Mr. Sandford Fleming to co-operate with the nominees of the Imperial Government and the Lower Provinces.

This appointment was communicated to the Governments interested, with the request that such action should be taken as would enable Mr. Fleming with his colleagues to commence the survey without delay. Mr. Fleming was however nominated by Nova Scotia and New Brunswick, and the Duke of Newcastle, then Colonial Secretary, likewise appointed him on behalf of the Imperial Government.*

In making the selection of Mr. Sandford Fleming as the representative of the Imperial Government while he at the same time was acting for the British American Provinces, it was felt that the Duke had

* The appointment was made by Despatch dated October 17, 1863, to the Governor General—The Duke says;—" the character of Mr. Sandford Fleming whom, in your despatch No. 81, you mention as having been nominated by the Government of Canada to undertake the preliminary survey of the line of Intercolonial Railway, is so unexceptionable; and "the selection of him by the Government of Nova Scotia and New Brunswick is such a "further convincing proof of his qualification for the office of Engineer for the line, that I am "quite ready to avail myself of his services as the representative of the Imperial Government. "Your Lordship will accordingly be pleased to appoint Mr. Fleming at once to the situation. "It is agreeable to me to feel that by selecting Mr. Fleming as the combined representative "of Her Majesty's Government and of the North American Provinces specially interested in "this important subject, much delay has been avoided, and that the wishes of your Govern- "ment for the immediate commencement of the survey have, as far as this appointment is "concerned, been complied with."

rightly appreciated the importance of avoiding the delay and inconvenience invariably attendant on divided responsibility.

In the meantime a discussion had arisen between the Governments of New Brunswick and Canada, respecting a misunderstanding which had occurred in the previous year. New Brunswick was willing to enter on the survey, but asked Canada to pledge itself to certain conditions regarding it. Canada, on the other hand, considered that negotiations should only commence when the survey was completed.

The Government of Nova Scotia regarded the proposed survey as indispensable and expressed its regret that any question had been raised at that time as to the extent to which the Government would ultimately be bound by it.

It does not appear that there was any actual settlement of the misunderstanding. But on the 20th February, 1864, the difficulty was for the time got rid of by a despatch from the Governor General to the effect:—that, in order to avoid delay, Canada had decided to undertake the survey on its own responsibility and at its sole expense; but that it would be for Nova Scotia and New Brunswick to consider, in event of the survey proving useful, if they would deem it right to pay their proportion of the cost.

On the 5th March, 1864, the Engineer left Quebec for River du Loup, the terminus of the Grand Trunk Railway, to commence a *reconnaissance* of the country and to arrange for forwarding the supplies necessary to the prosecution of the work. These operations had to be undertaken, in a country destitute of roads, on snowshoes and on dog-sleds. Nevertheless, on the opening of spring, a large staff of assistants were at work at various points between River du Loup and Truro.

The survey was divided into two sections, one extending south-easterly from the railway in operation between St. John and Shediac, to Truro, the then terminus of the Nova Scotia Railway; the other extending northwesterly from the St. John and Shediac Railway to River du Loup.

In the former division a range of high lands, known as the Cobe-

quid Mountains, had to be crossed. On the latter division for about 200 miles southeasterly from River du Loup, a broken, elevated country, covered by a dense forest, without settlements or roads, intervened. It is in this division that the Tobique, the Notre Dame, the Shik Shok, and other minor ranges of highlands, are met. Before the close of 1864 the country between River du Loup and Truro had been well explored, and more than one practicable line established.

The report of the survey was made on the 9th February, 1865, setting forth the routes surveyed, and such projected lines as seemed worthy of notice. It specially dealt with the means of meeting obstacles of a physical or climatic nature, and pointed out how difficulties of a serious character might be overcome. The quality of the land, and its fitness for cultivation and settlement, were reported upon; and approximate estimates of quantities of the work to be performed were attached. The comparative values of the various routes in a commercial point of view were also reported on.

In all fifteen different lines and combinations of lines, projected in various directions through the country, were compared.*

* *Table of Comparative Distances from River du Loup to St. John and Halifax.*

		TO ST. JOHN.			TO HALIFAX.		
ROUTES.	No. of line.	Railway Built	Not Built	Total.	Railway Built.	Not Built.	Total.
Frontier Routes.	1	27	292	319	184	401	585
	2	45	305	350	202	414	567
	3	00	301	301	157	410	561
Central Routes.	4	00	326	326	157	435	592
	5	00	328	328	157	437	594
	6	37	343	380	120	452	572
	7	77	449	426	80	458	538
	8	37	307	344	120	416	536
	9	77	313	390	80	422	502
	10	96	326	422	61	435	496
	11	37	323	360	120	432	552
	12	77	329	406	80	438	518
Bay Chaleur Routes.	13	37	387	424	120	496	616
	14	96	377	473	61	486	547
	15	96	390	486	61	499	560

PLATE NO. 3.

ROUTES PROJECTED FOR THE INTERCOLONIAL RAILWAY.
REFERRED TO IN
REPORT OF 1865.

Photo-Lith. by the Burland-Desbarats Lith. Co.

These lines were grouped under three distinct heads, and designated "Frontier," "Central," and "Bay Chaleur" routes.

The "*Frontier*" *routes* were three in number, and embraced the lines which closely approached, in some part of their course, the boundary of the United States.

"The "*Bay Chaleur*" *routes* were also three in number, and included those lines which in their course touched the shore of the Bay Chaleur.

The "*Central*" *routes* embraced all those lines projected though the

The following deductions may be drawn :—

Line No. 3 is the shortest Frontier Route *to St. John;* its total length is 301 miles, the whole of which is yet to be built. By this line the total distance to Halifax is 567 miles, of which 157 miles are constructed, leaving 410 miles yet to be made.

Line No. 4 is the shortest Central Route *to St. John:* its total length is 326 miles, the whole of which has to be made. By this line the distance to Halifax is 592 miles, of which 157 miles are built, leaving 435 miles to be constructed.

Line No. 13 is the shortest Bay Chaleur Route *to St. John;* its total length is 424 miles, of which 37 miles are constructed, leaving 387 miles to be made. By this line the total distance to Halifax is 616 miles, of which 120 miles are already made, leaving 496 miles to be built.

Line No. 3 is the shortest Frontier Route *to Halifax* as well as to *St. John*, the distances are already given.

Line No. 10 is the shortest Central Route *to Halifax;* the total distance by it is 496 miles, of which 61 miles are built, leaving to be built 435 miles.

The total distance to St. John by line No. 10 is 422 miles, of which 96 miles are built, leaving to be constructed 326 miles.

Line No. 14 is the shortest Bay Chaleur Route *to Halifax;* its total length is 547 miles, of which 61 miles are constructed, leaving 486 miles to be made. By this line the total distance to St. John is 473 miles, of which 96 miles are built, leaving 377 miles yet to be constructed

The shortest of all the lines to St. John is No. 3, Frontier Route.

The shortest of all the lines to Halifax is No. 10, Central Route.

Line No. 3 requires the construction of 25 miles less than No. 10, to connect River du Loup with both St. John and Halifax; but the total distance *to Halifax* by line No. 3, is 71 miles greater than by line No. 10, whilst the total distance *to St. John* by line No. 10 is 121 miles greater than by line No. 3.

The shortest route from River d Loup to the Atlantic Sea Board, on British territory is by line No. 1 *to St. Andrews.*

The total distance *to St. Andrews* b tnis line is estimated at 277 miles, of which 67 miles are constructed, leaving only 210 miles to be built.

The total distance *to St. John* by line No 1 is 319 miles, of which 292 miles require to be made.

The total distance *to Halifax* by line No. 1 is 585 miles, of which 401 miles require to be built.

interior of the country, at some distance from the frontier on the one hand, and from the Bay Chaleur on the other.

While in each case the general engineering features of the lines, and the nature of the country through which they were projected were set forth, the fact was prominently put forward that there was little prospect of any considerable amount of "local traffic" by any route, and that no profitable return could be looked for from that source for many years. It was likewise shown that no great proportion of "through freight," could, under ordinary circumstances be profitably carried over the proposed railway. It was argued that, during the season of navigation, freights could be more cheaply taken by water; and in winter, unless the United States placed restrictions on Canadian traffic, freight now passed in bond, would continue to follow the shorter routes to the Atlantic. On the other hand by opening up an outlet through British territory the effect would be that shorter lines through the United States would be kept under control. Accordingly, even when in no way used for freight, by the influence it would exercise on the customs' regulations, and the railway interests of the United States, the new line would directly benefit the agricultural and commercial interests of the Western Provinces.

It was claimed that a line touching the Bay Chaleur possessed special advantages in the matter of passenger traffic. Previous to the survey, the extension of the United States lines by the Atlantic coast to Halifax had been advocated with the view of reducing the time taken in the ocean passage, by shortening its length. Powerful influences had been enlisted to complete the coast line to Halifax. It was considered probable that, on the completion of this connection, most of the passenger traffic, not only from the United States, but also from the Province of Canada, west of Montreal, would seek Halifax through the United States, instead of passing over the Intercolonial via River du Loup.

The Bay Chaleur, however, is not only nearly a hundred and fifty

miles nearer than Halifax to Liverpool, but at the same time it is two hundred and sixty-six miles nearer Montreal than Halifax is. Consequently the selection of a port on the Bay Chaleur for ocean steamers would shorten the whole distance between Montreal and Liverpool fully four hundred miles. Even between Liverpool and New York one hundred and sixty miles would be saved by commencing the ocean passage at the Bay Chaleur.

The Intercolonial Railway accordingly presents an important route for ocean, mail, and passenger traffic, to Canada, the Western States, and to a large portion of the Central States.

These facts pointed to a line by the Bay Chaleur as preferable to the Central or the Frontier lines.

It was suggested that this line might exercise important influence on Newfoundland. The consideration of the shortest lines between America and Europe with reference more particularly to the conveyance of passengers and mails, pointed to the extension of the railway system across Newfoundland.* The theory was advanced that there already existed, or that in all probability there would soon be, sufficient traffic to sustain a daily line of ocean steamers across the Atlantic. The idea of including Newfoundland in the scheme of inter-communication and making a railway there, a continuation, as it were, of the Intercolonial line, with the prospect of the Island becoming part of the Federal Union may have appeared to be visionary. But nevertheless some advance has been made in that direction. In the ten years which have since elapsed, Newfoundland has been awakened by the spirit of progress, and she more thoroughly understands the importance of her geographical position. Last year, the interior of the Island, scarcely before trodden by the white man, and full of natural resources, was passed over by a large staff of engineers sent by her Government to examine the practicability of a railway from the extreme east to the extreme west. Another decade may record results such as the chronicler of

* See Appendix.

to-day gives to the world of what has been effected by the Dominion in the last ten years.

The report contained estimates of the probable cost of the Intercolonial Railway, which however, were necessarily imperfect, as they were based on the limited examination. The line surveyed through the interior of the country, was estimated at an average of $46,000 per mile, or $20,635,500, for a total distance of 458 miles, the length of new railway to be constructed.

Only a portion of the line since adopted by the Bay Chaleur, had then been tested by instrumental survey, but upon the data obtained, applied as an average, to the whole distance between River du Loup and Truro, the total cost was roughly estimated at $19,853,214. It was stated that it was possible that a less sum might suffice, but that until more elaborate surveys established the exact character of the work, the line could not safely be estimated under the cost of twenty million dollars.

While the survey was in progress in the year 1864, important movements were made towards the establishment of the Dominion.

The Governments of Nova Scotia, New Brunswick, and Prince Edward Island, were authorized by their respective Legislatures to enter into negotiations for the union of the Maritime Provinces; and a convention was appointed to meet in the month of September, at Charlottetown, Prince Edward Island.

In Canada, after a long contest, to a great extent the result of sectional jealousies between the Eastern and Western Provinces, it seemed as if parties had assumed such an attitude that the continuance of Government by a Parliamentary majority had become an impossibility. In Western Canada, it was maintained that that province, being the most populous, was unfairly represented in the Legislature. Eastern Canada, on the other hand, had held that no change could be made in the Union Act, which assigned equal representation to both provinces. To remedy the dissatisfaction, an attempt had for some years been made to govern by double majorities, in itself an unwieldy and impracticable arrangement.

This is not the place, however, to discuss the political events which led to confederation. It is enough to remark that there seemed to be no extrication from difficulties which threatened to become chronic, except in the adoption of some measure which would unite in a whole the several provinces of British America, so that more national interests and a wider field would cause merely sectional interests to be of secondary importance. It was felt by both parties that the time had arrived when decided steps should be taken. After much deliberation, it was determined with the general assent of the supporters of the government and of the opposition, to unite in one effort to secure the confederation of the Canadas with the Maritime Provinces.

On the prorogation of the Legislature in June, a fusion of parties took place, and a new government was announced, with the avowed policy of consummating the confederation of the British North American Provinces.

Eight of the members of the new executive were accordingly deputed to the convention of the Maritime Provinces, appointed to assemble at Charlottetown. The movement in Canada exercised great influence upon the events which followed. It had long been felt that from geographical position, and from distinct political organization, there had been but limited business relations, and an almost total absence of social intercourse, between the various provinces, which it was now proposed politically to unite into one great nationality. Accordingly, the inhabitants of St. John and Halifax considered it desirable to form the acquaintance of the political leaders of the provinces proposing to enter into alliance with them.

On the prorogation of the Canadian Legislature, the members of both Houses were tendered the public and private hospitalities of the cities of St. John and Halifax. The invitations were immediately accepted.

During the summer the visit was paid. A steamer with some three hundred representative men from all parts of Canada, from the banks of the St. Lawrence, from the Ottawa, from Central Canada,

from Toronto and its populous neighbourhood and from the shores of the upper lakes, landed in the Lower Provinces, where a series of banquets followed one on the other, where private hospitality was profusely offered and where abundant opportunities were created for the crowd of visitors to know the people, the industries and the resources of the Maritime Provinces, which were now visited for the first time, by nearly all those present.

The time-honoured custom of the British race, of inaugurating a great undertaking by festivities and hospitalities, ushered in the birth of the Dominion. The banqueting which commenced in the cities washed by the waves of the ocean, was repeated before many months throughout Canada; and the cities by the St. Lawrence and by the lakes gave back the echo of the cheers which had so lately been heard at the seaboard.

On the 8th September, the memorable meeting took place at Charlottetown, where representatives of Canada, New Brunswick, Nova Scotia, and Prince Edward Island were drawn together; but the larger question of a federal union of all the Provinces completely overshadowed the more limited question of a union of the Maritime Provinces for which the convention had been called.

After the adjournment of the convention meetings were held at Halifax and St. John. The question, however, had really been settled at Charlottetown; but the usual banquets followed, the customary speeches were made, and the subject was at each place thoroughly discussed.

In October 1864, with the sanction of the Imperial Government, a convention of delegates from all the Provinces, including Newfoundland, was held at Quebec; a series of 72 resolutions was adopted, by which it was proposed to unite Eastern and Western Canada with New Brunswick, Nova Scotia, and Prince Edward Island. At the same time, provision was made for the admission of the Territories then occupied by the Hudson Bay Company, together with British Columbia and Newfoundland.

These resolutions formed the basis of the articles of Confederation

subsequently incorporated in an Imperial act. The 68th resolution specially bears upon the subject of this volume; it was therein determined that "the general Government shall secure, without delay, the "completion of the Intercolonial Railway from River du Loup, through "New Brunswick, to Truro in Nova Scotia."

Within a period of five months, a series of important events happened with startling rapidity; events which culminated in a scheme that not only provided for the construction of the Railway which efforts extending over a quarter of a century had failed to secure, but that consolidated in one government Provinces scattered over half a continent, which had remained separate from the first days of their existence under British rule.

The resolutions of the Quebec convention, having received the approbation of the Imperial Government, were submitted to the Provincial Legislatures and sanctioned:

By the Province of Canada, on 10th March, 1865.

By the Province of Nova Scotia, on 18th April, 1866.

By the Province of New Brunswick, on 6th April, 1866.

The Provincial Legislatures also addressed Her Majesty the Queen, praying that a measure might be submitted to the Imperial Parliament to provide for the union of the whole of British North America. The Governor General, with deputations from the governments of the several Provinces, proceeded to England to arrange with the Imperial Authorities the preliminary steps. These deputations met in conference on the 4th December, 1866, in London.

A distinct provision for an Imperial guarantee of £3,000,000 sterling for the Intercolonial Railway, formed the substantial distinction between the resolutions agreed upon at Quebec, and those submitted to the Imperial Government at London. Her Majesty's Ministers submitted a Bill to the Imperial Parliament, designated the "British North America Act of 1867," creating the Dominion of Canada. The Bill received the royal sanction on the 29th March, 1867, and became, on the 1st July, 1867, the Constitution of Canada.

On the 12th April, 1867, the Imperial Parliament passed a second bill in the interest of Canada, entitled: "An Act for authorizing a guarantee of interest on a loan to be raised by Canada, towards the construction of a railway connecting Quebec and Halifax." Under this Bill the funds, to the extent of £3,000,000 sterling, for the construction of the Intercolonial Railway, were provided.

CHAPTER VI.

1867 TO 1876.

LOCATION AND CONSTRUCTION.

Effect of the Ashburton Treaty on the Location of the Line.—Railways previous to Confederation.—Commencement of Location Survey.—Rival Routes through New Brunswick.—Military Considerations.—Rival Routes in Nova Scotia.—Line Recommended.—Controversy respecting the Route.—Action in Nova Scotia.—The controversy carried to Ottawa.—Final adoption of the Combination Line.—Appointment of Commissioners.—The Contract System.—Tenders Received.—The Bridge Controversy.—The Engineer advocates Iron.—The Commissioners insist on Wood.—Iron finally adopted.—The Eastern Extension Controversy.—Line from Moncton to Amherst adopted.—Location between Miramichi and Moncton.—Construction proceeds under the Commissioners.—Completion of Line under Department of Public Works.

THE location of the line being necessarily confined to British territory, it was forced to make a considerable *detour*, to avoid entering the State of Maine. Had no national considerations presented themselves, or had the boundary been laid down according to the Treaty of 1783, or even in accordance with the settlement proposed, and, to some extent, pressed by the United States some years prior to the Ashburton Treaty, there would have been no difficulty in securing a direct, eligible route.

The Railway would, in this case, in all probability, have followed the general course of the route surveyed by Captain Yule, in 1837, for the St. Andrews and Quebec Railway, as far as the neighbourhood of the river St. John, but with such modifications and improvements as further surveys might have suggested. Owing to certain political influences Captain Yule was bound by his instructions to pass to the north of Mars Hill. Thus his line was deflected out of the direct course to the seaboard; and it is highly probable that untrammelled he would have followed a shorter route. It is evident, from an inspection of the map, and from the natural features of the country, that lines of railway might

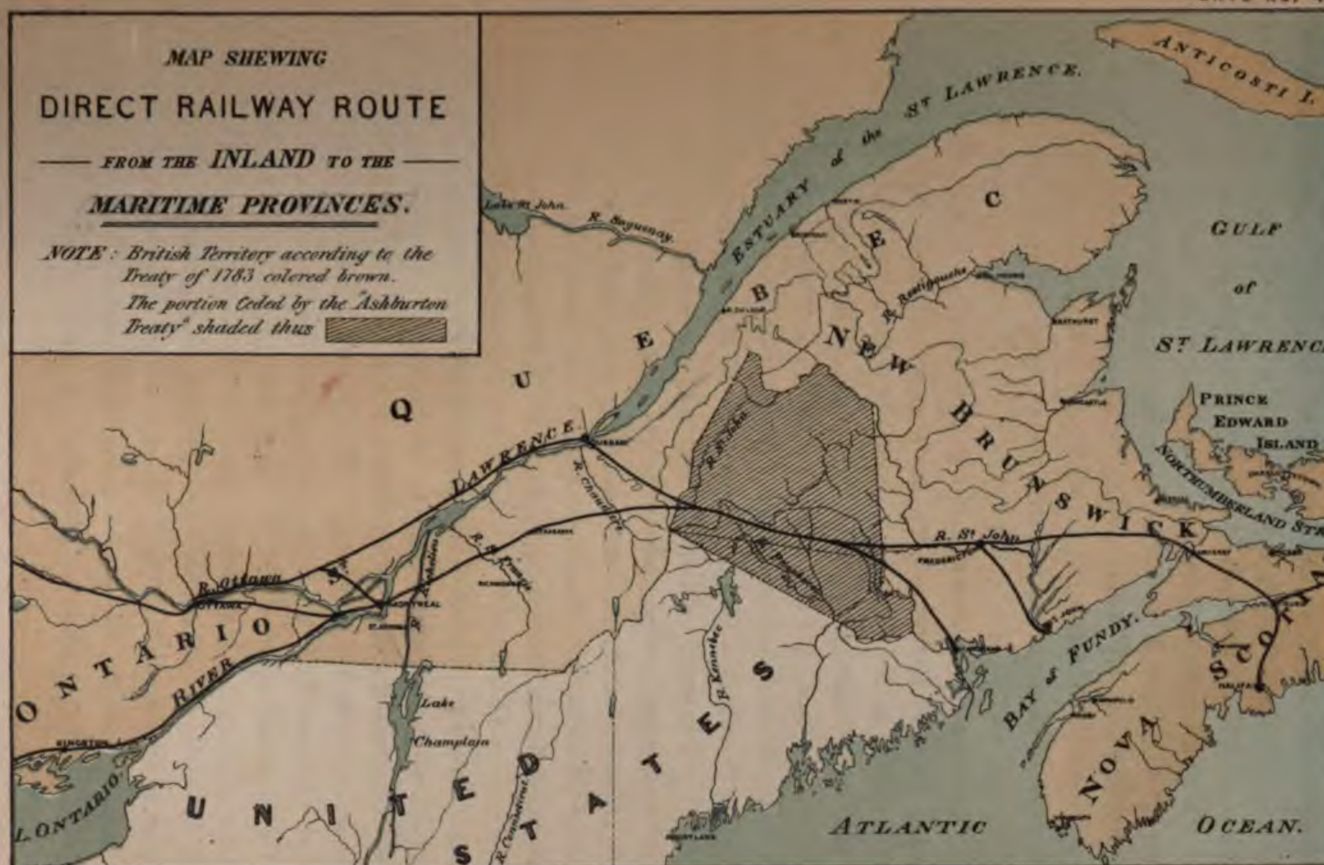
have been projected, so as to bring Montreal within 380 miles of St. Andrews, 415 miles of St. John, and 650 miles of Halifax; and that the distance from Quebec to St. Andrews need not have exceeded 250 miles; 67 miles less than to Portland. Fredericton, the seat of local government, would have been on the main line to Halifax, and distant from Montreal about 370 miles; and these lines, moreover, would have been wholly within the limits of the Dominion had the international boundary been traced according to the true spirit and intent of the Treaty of 1783.

The distance between Montreal and Halifax might thus have been lessened nearly 200 miles. St. Andrews would have taken the place of Portland as the winter terminus of the Grand Trunk Railway, and would have commanded, together with St. John, a traffic now cut off from both places, and centred at a foreign port.

The direct route would have brought the Springhill coal fields of Nova Scotia some 200 miles nearer to Montreal than by the present line of the Intercolonial, and would have rendered it possible to transport coal by rail at a comparatively moderate cost.

If, under such circumstances, an Intercolonial line to connect the cities of the Maritime Provinces with those of the St. Lawrence had been constructed, the building of 250 miles of railway representing an expenditure of $10,000,000 would have been unnecessary. Great as this saving would have been, the economy in working it and in maintenance would have been more important. The direct line would also have attracted certain branches of traffic which by the longer route must either be carried at a loss or be repelled. These considerations render the difference in favour of the direct line incalculable, and cause the more regret that the treaty made by Lord Ashburton, which ceded British territory equal in size to two of the smaller States of the Union, rendered such a direct line through British territory forever impossible. Although it is too late to rectify this almost fatal error, it is important in a history of the Intercolonial Railway to recount all the steps by which so costly a consequence has been forced upon the Dominion.

PLATE NO. 4.



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It has already been mentioned that previous to Confederation in 1867, the separate Provinces had commenced, within their own limits, systems of railways demanded by their own requirements. In Canada proper a railway had been built from the river St. Clair, at the extreme West, through Toronto, Montreal, and Quebec, to river du Loup. In Nova Scotia, the line from Halifax to Truro had been completed; and in New Brunswick, St. John had been connected with Shediac upon the Gulf of St. Lawrence. These important but distinct sections it became the first duty of the Dominion Government to connect by the most advantageous route possible through British territory.

The British North America Act, uniting the Provinces in one Dominion, came into force on the 1st of July, 1867. One of the stipulations was that the Railway should be commenced within six months, and be finished within four years.

A week had not elapsed after the date of union when the Engineer-in-Chief received instructions from the Minister of Public Works to proceed with the surveys necessary to establish the location.

The season of 1867 was occupied in ascertaining the best position for the Railway between Truro and Amherst, and, in February of the following year, plans and profiles of a route from Truro to the boundary between Nova Scotia and New Brunswick were submitted to the Government for approval.

In 1868, the surveys were continued on the whole line, and a large engineering staff was employed in examining the country between Nova Scotia and river du Loup. A controversy arose between the advocates of different routes through New Brunswick. The press teemed with articles on the subject, and the contest was carried into the Legislature and Privy Council of the Dominion. The chief contest was between a Northern or Bay Chaleur route, a Central route and a Frontier route by the valley of the river St. John, which for a great length, would be close to the boundary between New Brunswick and the State of Maine. The advocates of the Frontier route set military considerations altogether aside. They contended that since the day of Major Rob-

inson, who first recommended the Northern route, the revolution in naval armaments had placed the two lines on an equality; that treaties had opened the Gulf of St. Lawrence to all nations; that there were no grounds for anticipating difficulties with the United States, as their interests were all on the side of peace; that, should any disturbing element arise, it would be settled by the pen, and not by the sword; and that, if the Railway should be constructed as a military road, it would be in danger wherever placed, and would, from that point of view, invite attack, while, if regarded as a commercial enterprise, its peaceful mission would be its protection. They further argued that a vast amount of public money would be saved by the adoption of the Frontier route. Owing to the length of line in operation which could be available, a much less length of new railway would be required; 55 miles of railway, already constructed and in operation, being purchasable at a low price. They farther argued that, the valley of the river St. John being well settled, there would be a considerable revenue from the ordinary trade of the district; and that there would also be a large lumber trade from Aroostook, in Maine, as well as from the New Brunswick counties.

It was, however, asserted on the other side, that on the Northern line there were many large lumber establishments, some of which would turn out more sawn lumber than all the mills between Fredericton and the source of the St. John, including those in the Aroostook country; that such a line would certainly benefit and develop Aroostook; but what was wanted was a railway to develop the resources of Canada; and that the population per mile on the Northern route was much larger than that on the Frontier route, even including the population of Aroostook, which amounted to about one-half of the total number named.

The advocates of the Northern route also claimed that the estimates of the Frontier line were placed at too low a figure, as the Railways offered for sale were sunk in debt, and were in such a bad condition as to require extensive repairs; and they contended that the Frontier line,

in its entirety through to Truro, would be more costly by $1,000,000 than the Northern line. They also showed by the long-continued negotiations, that neither the Provincial nor British Governments ever lost sight of the necessity of consulting military considerations; and that one of the latest Colonial Secretaries had said emphatically that no line which did not secure the advantages of a safe military road would ever receive the countenance of the British Government.

The contest which was most persevered in was however between the Central and Northern routes; the Central being mainly advocated in the interest of the city of St. John.

The safety of the Railway from attack in time of war continued to occupy a prominent place in these discussions. It was asserted that the Northern route, recommended by Major Robinson because "passing at the greatest distance from the United States, and possessing "in the highest degree the advantage of security from attack in case of "hostilities," was, in reality, greatly exposed to attack, as, at several points, it was close to the sea; and that operations could be more successfully carried on against it than against the Central route, which, at all points was at least 30 miles distant from the American frontier. It was held that this distance was sufficient to make the Railway safe, or at least as safe as a considerable portion of the Grand Trunk Railway westwards from river du Loup; and that it would be so regarded by the British Government.

On the other side, it was denied that the Northern line was open to attack, as only vessels of light draught could enter the waters which it touched; and that an enemy's fleet could not enter the Gulf of St. Lawrence, except at the risk of being cut off from support and supplies; whereas, an attack could be much more readily made on the Central route, St. John city and river being comparatively near American harbours. Besides, the long vulnerable portion of the Central line would not be so defensible as the portion of the Grand Trunk Railway lying nearest the American frontier. because, in the latter case, there was an intervening range of mountains impracticable for the passage of troops

and heavy artillery; while in the former, the line passing into the valley of the St. John, the river would afford ready means of attack.

As in the case of the Frontier route, an argument was advanced in favour of the Central route on account of the less length of railway required. But to maintain this argument it was stated that no railways on the route would have to be purchased, because the companies owning them would willingly grant running powers over such as were constructed. On the other side it was shown that the project was not in accordance with the designs of the British Government, as evidenced by their proposed guarantee being for £3,000,000, with the condition that the Dominion Government would raise a further £1,000,000, whilst the estimate of the cost on the Central route was less than the £3,000,000. It was accordingly argued that a continuous line of railway was contemplated, and not a connection with railways in operation. A forcible objection was made to the Central route, that one of the railways proposed as a connection was owned or controlled by citizens of the United States. Offers to carry troops in case of need were made to meet this argument. But it was evident such offers could not be enforced: on the declaration of war the railway companies could readily withdraw all their rolling stock within the United States frontier, and leave the railway useless to the Dominion though available to the enemy.

Some stress was laid on the amount of through freight which would follow the Central route to St. John as a shipping port. It was, however, contended that through freight from Montreal would take the line of the Grand Trunk Railway to Portland, and not a route 300 miles longer by river du Loup to St. John. Also, it was contended that, in the matter of breadstuffs and provisions, the United States was the natural market for St. John. Trade returns showed that, while restrictions were laid upon trade between the British North American Provinces and the United States, the supply of breadstuffs and provisions for St. John went from Canada; but when reciprocity prevailed this supply came from the United States, to the extent of 75 per cent. of the

whole. It was further argued that, if reciprocity should be again established, the through freight would prove a nullity.

On the side of the Northern Line, it was argued that the natural trade of the populous region through which it would pass had, even during the existence of the Reciprocity Treaty, been with Canada; the imports of flour from the United States never having exceeded between 10 and 15 per cent. of the total imports, unless under exceptional circumstances.

It was said that the Central route had nothing in its favour which the Northern had not; but that the Northern had many special advantages over the Central and every other route. It would undoubtedly fulfil the national object for which the scheme was first originated, viz:—the creation of a safe military road not open to sudden assault either by land or sea. It would pass through much well-settled country, including several important towns and villages; and would traverse many outlets by which lumber is brought from the interior. A considerable trade might be looked for in grain, and, eventually, in manufactures, from Ontario to the Maritime Provinces; and very probably return freight at cheap rates would be obtained in coals, minerals and fish.

The fish trade was held to be of great importance and worthy of being fostered as productive of profit. Fish, cured and dried, was sold for about three cents per pound; if packed in ice and transported to Quebec or Ontario it would bring ten cents per pound. As the cost of curing and drying was equal to the cost of carriage, the ten cents per pound for the frozen fish would afford a larger profit to the fishermen, would foster this branch of trade, and would speedily develop this class of railway traffic.

The claims of Prince Edward Island and Newfoundland were urged in advocacy of the Northern route, inasmuch as it was generally considered desirable to consolidate the Dominion by including these Islands in Confederation; and it could not be doubted that the Northern route would be the most acceptable to them, particularly to New-

foundland, in view of the quick trans-Atlantic route by way of that Island suggested by the Chief Engineer in his report of 1864.

While the discussion proceeded and the objections against each route were being answered by arguments based on commercial theories of profit; and while each particular route, in its turn, was zealously advocated and its merits enlarged upon by its friends, the Chief Engineer avoided all expression of opinion as to the line he held to be preferable; a course of action which was made a matter of reproach to him by both sides in the controversy. Viewing the course pursued, he entertains, after the lapse of years, the opinion by which he was then guided, that it was unnecessary and would have been impolitic, for him to have taken part, in any way, in the discussion.

When Mr. Fleming entered upon the survey in 1864, his instructions on this point were very plain. He was not called upon to select what he held to be the most eligible line: indeed, as he read his instructions, he considered it to be his duty to withhold all indications of preference. His own opinions were, however, explicitly and directly expressed, when it became his duty to place them on record. In March, 1868, he was requested by the Government to report on the route he held to be the best.

He replied that military considerations as well as the commercial capabilities of the line had to be regarded. With a prospective increasing traffic, the railway would probably become self-sustaining, but on the other hand, a line with little traffic, and with no likelihood of any great increase, threatened to become a permanent burden.

There appeared to be but little prospect of much local traffic on any of the routes. Agricultural prospects were nowhere extremely promising; and, except in Nova Scotia, the mineral resources of the country, as far as known, appeared of little importance. It was, indeed, difficult to foresee that any great development of purely local traffic would take place. The most exaggerated estimates of way business, on any of the routes, for a long time were anticipated to fall short of the cost of maintenance.

In the matter of through traffic, the fact had to be taken into consideration that a railway was being constructed to connect St. John New Brunswick, with Bangor in Maine, and thence with the railway systems of Canada and the United States. This line would be a formidable competitor to the Intercolonial Railway, if the latter were built on either a frontier or central route, while the route by the Bay Chaleur, and the adoption of a port on that Bay, for ocean steamers, would enable the Intercolonial Railway to command a large share of the rapidly increasing mail and passenger traffic between Europe and America.

The Chief Engineer, after examining the arguments advanced in favour of each route, placed on record his opinion, that, beyond a doubt, the line by the Bay Chaleur was the route to be adopted.

The Imperial authorities never lost sight of the military element which the railway should retain. On several occasions they clearly intimated that a northern or Bay Chaleur route was the one which they preferred: not only Major Robinson, but other military authorities pointed out the northern route as the proper location. The commissioners appointed to consider the defence of the Province of Canada reported in 1862 that no time should be lost in opening a road by the valley of the Metapedia to Metis on the St. Lawrence, and that, for military purposes, the preference should be given to the line of Railway by the Bay Chaleur.

In 1864 the Deputy Director of fortifications, Col. Jervois, reported that whilst the Temiscouata route by Grand Falls and Fredericton to St. John was, on account of its proximity to the American frontier, liable to be cut off at the commencement of hostilities, the route from Halifax through Nova Scotia and along the Eastern side of New Brunswick, called the Metapedia route, would afford access to Canada during war; and that, except at the part where it runs along the Southern shore of the St. Lawrence, where, owing to the nature and position of the country in the adjacent part of the States, it is scarcely subject to attack, the whole line might be held to be at such a distance from the frontier that it would not be liable to interruption by an enemy.

Were further evidence required of this feeling, it is to be found

in the fact that the Duke of Buckingham sent a despatch to the Governor General in the spring of 1868, intimating that the Imperial guarantee would at once be made available provided the Bay Chaleur route was adopted, and, on receiving notification of the choice of route, the Duke forwarded a second despatch which fully establishes that the route by the Bay Chaleur was held to be the only line which provides for the national objects involved in the undertaking.*

During the period that the location through New Brunswick was the matter of daily debate, the course of the line in Nova Scotia was also discussed, with equal warmth and pertinacity; more especially that portion, some thirty miles in length, in which the mineral districts adjoining the Cobequid mountains are included. The chief promoter of these discussions was Mr. John Livesey, who represented the Londonderry Iron Mines, and who for more than four years never ceased to put his views forward.

From the time of the survey made in 1864, Mr. Livesey continually

* DOWNING STREET,
22 July, 1868.

(COPY CANADA, No. 155.)

MY LORD,

" I have received your Lordship's telegraphic message that the route by the Bay of Cha-
" leur has been selected by the Canadian Government, as the one to connect Truro with
" River du Loup and thus complete the Intercolonial Railway.

" I understand three routes to have been under the consideration of the Government of
" Canada, namely, one crossing the St. John river either at Woodstock or Fredericton, the
" second in a more central direction through New Brunswick, and the third following the line
" selected by Major Robinson in 1848.

" The route crossing the St. John river, either at Woodstock or Fredericton, is one to
" which the assent of Her Majesty's Government could not have been given. The objec-
" tions on military grounds to any line on the South side of the St. John river are insupera-
" ble. One of the main advantages sought in granting an Imperial guarantee for constructing
" the railway, would have been defeated, if that line had been selected.

" The remaining lines were the Central line and that following the general course of the
" route surveyed by Major Robinson,—and Her Majesty's Government have learned with
" much satisfaction that the latter has been selected by the Canadian Government. The
" communication which this line affords with the Gulf of St. Lawrence at various points, and
" its remoteness from the American frontier, are conclusive considerations in its favour, and
" there can be no doubt that it is the only one which provides for the national objects
" involved in the undertaking."

I have etc., etc.

Signed, BUCKINGHAM & CHANDOS.

To Governor the Rt. Hon. Viscount Monck.

urged, both privately and officially, the importance of locating the railway on a route passing close to the furnaces of the Iron Mines in which he was interested.

Four different routes between Truro and a point of junction on the railway from St. John to Shediac were examined and reported on; one was far to the east, another was far to the west, two were central. By combining parts of these central routes, two other routes were compounded. Of the two central routes, one was essentially the same as that recommended by Major Robinson in 1847. The other was similar to that advocated by Mr. Livesey. It was by a combination of the two that the route called "Line 6" was formed, to cross the Cobequid Hills by the pass at Folly Lake and to descend by the northern slope of the Hills towards Amherst. It was held that this line would best accommodate all interests, having primary regard to general convenience.

In 1865, the Government of Nova Scotia directed Mr. Fleming to report on the best route from Truro to the boundary of the Province. In June of that year he recommended that a central route should be adopted. From commercial considerations, a central route appeared to him the most important, as it would accomodate the Iron District on the Cobequid Range, and open up the Springhill coalfield. He was accordingly instructed to proceed with the location of the most eligible line on a central route.

The working season of 1865 was occupied in surveys. Every pass across the Cobequid mountains, within the limits of the iron district, was examined, and every effort was made to secure a practicable line near the Iron works. Six lines were surveyed, designated by the letters A, B, C, D, E, F.

The first kept the southern slope of the Cobequid Mountains, crossing the Folly River and the two branches of the Great Village River, passing immediately on the South side of the Acadia Iron Works. Afterwards it turned northwards, and crossed to the north side of the hills by a gorge, known as Madison's Brook, and by Isaac's Lake on the summit, 686 feet above sea level.

The line B passed close to the Acadia Iron works, thence turning northwards it followed the Great Village River, on which the works are situated, to the summit at Sutherland's Lake, where the elevation is 745 feet above sea level.

Lines C, D, E and F all passed by Folly Lake, where they attained the summit level of 590 feet above sea level.

Of these lines, B was the shortest, but had the most objectionable grades. F was second in point of length, and had the most favourable grades. A was fourth in point of length, and second in favourable grades.

Line A, passing close to the Acadia Iron Works, was advocated by Mr. Livesey. The Chief Engineer, on the contrary, gave it as his opinion that line F was in all respects entitled to the preference, and that, in view of its engineering features, he would recommend it for adoption.

The Engineer considered that lines A and F would equally well accommodate the Springhill coalfield; that though F would not accommodate the then existing iron works so well as A, it would equally well accommodate any extension of the works, and give much better accommodation to the traffic of the villages on the Gulf coast. He showed also, that, although Mr. Livesey had in some of his letters endeavoured to convey the idea that line F "just skirts the eastern edge" of the ore district, a former manager of the works had conveyed the impression that the ore deposits were equally on each side of line F, and that they extended over a large area in both directions.

Other evidence of the same import was furnished by a map and pamphlet, issued some years previously in the interest of the iron mines, which contained reports of several mineralogists and mining engineers. One of these writers expressed his opinion that east of the Folly River there were deposits of ore sufficient to produce from 20,000 to 24,000 tons of metal annually, while the works at that time situated to the west of Folly River were only capable of producing about 2000 tons per annum. It was, however, possible to extend them so as to produce from 10,000 to 12,000 tons per annum. The map accompanying the pamphlet

showed the "proposed site of new works," one on the Folly River, and another on Pine Brook, two miles east of Folly River.

It could not therefore be maintained that the route F, by Folly Lake, would not extend ample accommodation to the mineral region.

In August, 1865, a contract was entered into between the governments of Nova Scotia and New Brunswick, on the one side, and the Intercolonial Contract Company of London, on the other, for the construction of the railway between Truro and Moncton. The Government of Nova Scotia, having in May, 1866, received the report of the Chief Engineer, endorsed his views in reference to the Folly Lake route, Line F, and refused to sanction the construction of this portion of the railway under the contract which they had made with the Intercolonial Contract Company, unless the Company adhered to line F.

The members of the Nova Scotia Government were personally on friendly relations with Mr. Livesey. And, as that gentleman took every opportunity of enforcing his views, the members of the government were fully informed of the importance of the iron works, and of the expediency of selecting a route as favourable to them as the general interests of the country would permit.

After Confederation the Chief Engineer received instructions from the Dominion Government to locate the line from Truro to Moncton. At this time the Dominion Ministry had Mr. Fleming's report of May 1866, approved of by the Nova Scotia Government. The marked feature of these instructions was that he should adopt the most eligible line, giving due weight to the cost of construction, cost of future working and management, and also to general interests.

From the above facts it is evident that no course was open to the Chief Engineer other than to follow the line designated F.

But Mr. Livesey was not satisfied with this course, and in September, 1867, he addressed a letter, enclosing a copy of the correspondence, to the then Minister of Public Works, and in consequence the Chief Engineer was instructed again to consider the case between the two routes with regard to:—

1st. "The local traffic likely to be obtained by these lines respectively."

2nd. "The development of natural sources of wealth in the vicinity "of those lines respectively, by reason of their construction."

In September, 1868, the Chief Engineer accordingly reported on the rival lines A and F, and showed that the line F was preferable to A under the considerations of length, cost of construction, grades and curves, and consequently in cost of future working and management. Although the line, as located, crossed and passed near to valuable deposits of iron ore, it did not run sufficiently near to the iron works to be of full service without the construction of a Branch, some 7 miles long.

The cost of construction of line F and a branch would be considerably less than that of line A, without adding to A for the extra cost of working it. It was of importance that the iron works should have the benefit of railway service, and it was desirable that the earliest possible connection, consistent with general interests, should be made with them and the Springhill coal mines. It was considered that line F and a branch to the iron mines would also extend a connection with the coal mines, so much more favourable for cheap transport than line A that it would prove to be the most economical route for mineral traffic.

The decision arrived at was based on a comparison of the lines. Line F passed over a summit 100 feet lower than that crossed by Line A; it was the best, the shortest, and, even including the branch to the iron mines, the cheapest, and was therefore entitled to the preference. A combination line was mentioned as having been traced on new ground between lines F and A. It was four miles longer than line F but reduced the branch from seven miles to three. In the comparison, the Engineer considered the combination line second in point of merit to line F, and in his opinion line A was the least favourable of the three.

On the other hand Captain Tyler, Government Inspector of Rail-

ways, England, was applied to by Mr. Livesey. and reported in July 1868, that in his opinion, taking into account cost of construction, working over the super-elevations, counter gradients and curves on steep gradients, line A would still be considered cheaper than line F; that the construction of line F instead of line A appeared to him, from every point of view, to be a great mistake; and that the manufacture of iron in a cheap form by the use of Springhill coal was of so great importance that "such an obstruction to the development of such re-"sources, as the construction of line F *when line A is available and less* "*costly*, would be nothing less than a general misfortune to the indus-"trial interests of the Dominion."

In replying to this letter of Capt. Tyler, the Chief Engineer stated that he was satisfied that Capt. Tyler, and Mr. Atkinson who had worked out the calculations for Captain Tyler, were not in possession of all the information which the survey afforded, and therefore that their conclusions, based on imperfect data, could scarcely be correct; and he repeated that without capitalizing the extra cost of working line A, this line would cost, in construction alone, about $100,000 more than line F with a branch to the iron mines; that line F was the cheapest to operate, the shortest, and as far as he could judge, the best in every respect.

During the months of September and October, 1868, Mr. Livesey had test pits sunk in nineteen cuttings on line A, which had been assumed in the Chief Engineer's estimates as either wholly or almost wholly rock, and he reported that a very large deduction should consequently be made from the estimated cost of line A. This deduction was at once made by the Chief Engineer; but nevertheless he saw no reason to make any material change in the views he had expressed, and he maintained that although line A had been surveyed, tested, revised and improved by repeated trial surveys, it remained substantially as it had been originally described by him; and that it was his deliberate opinion that, taking the two lines as they were then represented by plans and profiles, line F was capable of doing, at the same cost of working

expenses, at least ten per cent. more business than line A, and that no improvement could be made in line A that would materially lower the cost of working, without at the same time greatly increasing the cost of construction.

Other parties took part in the discussion, amongst whom were the Hon. R. B. Dickey, the Hon. A. W. McLelan, afterwards one of the Railway Commissioners, Mr. Morrison, M. P. P. for Colchester, and Mr. Purdy, M. P. P. for Cumberland.

Notwithstanding that the Government of Nova Scotia had, in 1866, endorsed the views of the Chief Engineer with regard to line F, the Executive Council of Nova Scotia, on 3d August, 1868, passed a Minute, which was approved by His Excellency, the Lieut. Governor, to the effect that, in the interests of the Province, the location of line A should be adopted in preference to that of line F.

It was stated by one of the gentlemen referred to, in a letter dated 21st September, 1868, that this Minute of Council, though passed on 3d August, was not communicated to the House of Assembly until 15th September, and that the House of Assembly was indignant at the action of the Government. Three days afterwards the House of Assembly passed a resolution in favour of the Folly Lake route, line F.

A few days after the passing of this resolution, the Chief Engineer, by request of the Government of Nova Scotia, met the Members of Council at Halifax. There were, however, only three members present. After hearing full explanations, they concurred in the views of the Engineer with respect to the adoption of line F, and freely told him to state to the Dominion Government the result of the interview. They further intimated that they would make a Minute of Council, expressing their concurrence, but that they felt themselves precluded from doing so by the minute which they had previously been induced to pass, without sufficient knowledge of the facts.

The controversy was carried to Ottawa. One Nova Scotia gentleman, in pressing his views on the notice of the Secretary of State for the Dominion, drew attention to the claim advanced on behalf of the

iron mines with respect to the large capital invested by the company, and met this claim by saying that the people in the villages on the Gulf coast had invested infinitely more capital in building wharves, clearing lands, building roads, bridging streams, opening stone quarries, building ships, working copper mills, and that they were at that time employing more men, developing interests of more real and lasting benefit, and contributing more to the Dominion revenues, than the mining company. He contended that all this population, which he estimated at 10,000, should not be forced to pass over 12 miles more of mountain roads to get to the railway, because the Mining Company had located their works on the least eligible route.

The local advocates of both lines, at considerable length, exhausted every argument in favour of the line which each advocated. Their arguments were based on the population and agricultural products of the district; and the controversy branched off into a discussion respecting the distances from certain points to the line of railway, and to other unimportant matters of a purely local nature.

A line has already been referred to, which was designated the "Combination line," from the fact that, by a cross branch from the one to the other, it combined portions of both the rival lines, and as it would thus unite the local interests, previously in conflict, the combination line was favoured by both contending parties. This line connected the eastern portion of line A with the western portion of line F, the connection passing within three miles of the iron mines.

On the 4th November, 1868, the Chief Engineer was called upon for a report. He adhered to the opinions previously expressed as to the engineering advantages of line F, but he was prepared to admit that the combination line appeared to possess certain commercial merits. It would accommodate the population on the Gulf coast equally with line F, it being in fact identical with line F, from Folly Lake northwards, and at the same time it would afford greater accommodation to the iron works.

The combination line, it is true, would be some four miles longer than

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On Mr. Coffin's resignation the Hon. A. W. McLelan was appointed. Mr. Fleming still remained the principal executive officer.

Under the terms of the Statute, the appointment of all officers, except the Chief Engineer, was left to the Commissioners. They accordingly engaged a secretary and an accountant, and formally re-appointed the engineering staff, which, at that time, consisted of three district engineers, together with resident engineers and the necessary assistants, for each separate surveying party.

The Chief Engineer, with the three district engineers, met the Commissioners on the 30th December, 1868, at St. John, N. B., for the first time. At this meeting the Commissioners announced their intention to alter in some essential points the specification and system of contracts previously determined on. The proposed changes had reference to the basis on which contracts should be entered into, and to the character of the bridges. The Commissioners had resolved to make the bridges of wood, instead of iron as recommended by the Chief Engineer.

The Government had previously determined to construct the line in short sections of about 20 miles, and concurred in letting the work by measurement and price, as a schedule contract. The Commissioners declared themselves in favour of letting each section at a bulk sum for the whole, and not by a schedule of prices; and they recommended this plan to the Government.

The Chief Engineer objected to this principle, but his objections were not entertained. Accordingly, he felt himself constrained to submit his views on the subject to the Government. While, on one hand, he felt bound to follow the instructions of the Commissioners, he was also, directly responsible to the Government for any advice he tendered; and if, on essential points, his views differed from those of the Commissioners, his duty was to submit the difference to the Executive, and in defence of his own reputation, to place his opinions on record.

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The opinion of the Chief Engineer was, however, not sustained, and tenders were asked on the bulk sum system.

In February and April, 1869, tenders for bridging and grading 161 miles, divided into seven sections, were received. The following list will show the great difference of value attached to the work:

					Lowest Tenders.	*Highest Tenders.*
Division	A.	Section	No. 1,	20 miles	$ 175,000	$ 700,000
"	B.	"	" 2,	20 "	299,000	820,000
"	K.	"	" 3,	24 "	288,000	936,000
"	X.	"	" 4,	26 "	297,000	918,000
"	C.	"	" 5,	26 "	845,997	1,014,000
"	L.	"	" 6,	21 "	237,000	633,150
"	Y.	"	" 7,	24 "	333,600	1,008,000
Total,				161 miles.	$1,975,597	$6,029,150

Generally speaking, the lowest tenders were accepted, and the work was placed under contract.

The tenders varied in the aggregate from less than two millions to more than six millions, or to the extent of fully 300 per cent., and showed that the parties who tendered, had imperfect ideas of the work which they offered to perform. It is not surprising, therefore, that, before the expiration of twelve months, five out of the seven contracts had to be annulled and relet at a large advance.

The failure of the first contractors to complete their engagements, established that the proper course had not been followed in the first instance. An attempt was made to remedy the evil, as far as it could possibly be done, by furnishing contractors with more complete data, but no change was made in the principle of letting the work. The "schedule price" system was not entertained, for it was held that the Commissioners were committed to the "bulk sum" form of contract, and that, accordingly, it could not be departed from.

One important point, on which a serious difference of opinion arose, was in regard to the bridges. In the specification submitted by the Chief Engineer to the Privy Council, the abutments and piers were designed to be constructed of the best description of masonry, with iron superstructure.

It appeared to the Chief Engineer that great precautions should be taken with these structures, in order to have them permanent. Iron and stone being the most durable materials, their use would remove risk of accident from fire, and from natural decay. And, although the first cost might be greater, the permanent structures would avoid the constant periodical charge for restoration which wooden work would require. Moreover, the geographical situation of the line admitted of the delivery of materials by sea-going vessels, directly on the line at convenient points; so that the first cost of iron structures would be reduced to the least possible amount.

The Commissioners entertained the opposite opinion, and decided that the bridges should be constructed of wood.

The position was one of difficulty. The Chief Engineer was desirous of avoiding all cause of difference with the Commissioners; but his deliberate opinion was on record. The ground assumed by him had not been lightly taken, and the more the subject was considered by him, the more convinced he felt of the correctness of the principles of construction which he had advocated. No argument, however, which he could advance, appeared to have the least weight with the Commissioners. They had determined to make certain changes; that the recommendations of the Chief Engineer should be set aside; and that iron should not be used, but that timber should take its place.

In January, 1869, the Chief Engineer made his first appeal in the matter, to the Premier, Sir John A. Macdonald, and he submitted at length the arguments why iron and not wood should be used. This letter was referred to the Commissioners in the usual course. It has never been replied to; and the arguments advanced in that communication remain to this day without refutation. But the decision of the Commissioners was sustained. Five of the bridges were, however, exempted from the principle originally laid down by the Commissioners; otherwise, the order was given that all the bridges should be built of wood.

In May, 1870, the Chief Engineer recurred to the question, in a statement prepared for submission to Parliament. A complete list of the bridges was given, and it was there set forth that the cost of constructing them of iron would be but slightly in excess of building them of wood, and accordingly he recommended that iron should be used.

The Railway Commissioners still adhered to the view they had previously expressed, for, in a majority report, signed by Messrs. Brydges, Chandler and McLelan, they repeated the recommendation that, with the exception of the five bridges named, wood should be used throughout the line. This report is dated 3d July. Mr. Walsh, however, the remaining Commissioner, and Chairman of the Board, on the 5th July, gave his opinion in favor of iron. The matter was thus again brought before the Government, and on the 7th July an Order in Council was passed, affirming the decision of the majority that wood should be used. The Chief Engineer took another opportunity of appealing to the authorities on the subject. On the 25th July, he wrote to the Premier, Sir John A. Macdonald, and on the 22d August to the Commissioners. In the latter communication he asked a delay of ten days for some work in progress, so that the matter could be reconsidered by the Government.

In September, Mr. C. J. Brydges, one of the Commissioners, addressed, on his own account, a communication to the Privy Council on the subject. He argued that the fear of wooden bridges catching fire was groundless; that, in his experience of eighteen years as a Railway Manager, he had known no instance of a wooden bridge having been injuriously affected through the cause assigned. He contended that the Chief Engineer's calculations of quantities and cost were erroneous, that iron bridges would cost at least $300,000 more than the sum named, and that their introduction would probably add $500,000 to the cost of the line and would cause delay and confusion.

Mr. Fleming replied to the communication. He cited two instances of bridges on the Grand Trunk Railway, under the management of Mr. Brydges, having been destroyed by fire but a few weeks before the date

of Mr. Brydges statement. Mr. Fleming contended that his estimates were correct, and challenged examination into their accuracy: and he further made a final appeal in favor of iron bridges.

After an examination which established that the estimates of the Chief Engineer were correct,* the Commissioners eventually withdrew their objections and recommended that all bridges over 60 feet span should be built of iron. But the Chief Engineer persisted in his efforts to have every bridge, down to the smallest span—24 feet—made of iron, and at last, by an Order in Council, dated 12th May, 1871, authority was given to have them so constructed.

With the exception of three structures built of wood by direction of the Commissioners, against the protest of the Chief Engineer, all the bridge spans, of whatever width, throughout the line, have the superstructure of iron.

At the period when the Commissioners were appointed, the line had been determined from river du Loup to the river Miramichi, and from the northern boundary of Nova Scotia to Truro, but the location of the intervening distance of about 120 miles had not been made.

It has already been mentioned that contracts had been made in 1865 between the Intercolonial Contract Co. of London, and the Governments of Nova Scotia and New Brunswick, for the construction of the line between Truro and Moncton, with the design that this section should eventually form part of the Intercolonial Railway. In the winter of 1866–67 the Intercolonial Contract Co. failed, and assigned their contract to Messrs. Clark, Punchard & Co.

By the provisions of the contract between the Company and the Government of New Brunswick, it was set forth that the railway should intersect the St. John and Shediac Railway east of Moncton, and should pass the village of Dorchester within a specified distance.

* Mr. Fleming's original estimate of the cost of bridges with iron superstructure, including masonry, was $1,294,607
With wooden superstructure 1,293,459
The actual cost erected, completed, with iron superstructure, ... 1,274,027

The British North America Act was passed in March and came into force on the 1st July, 1867; and, as it contained provisions for the immediate construction of the Intercolonial Railway, the Government of Nova Scotia took steps to nullify the contract within the limits of that Province, no work having been executed. At the same date but limited action had been taken either by the Company or by their assignees within the Province of New Brunswick. At this stage of affairs the New Brunswick Government would also have been justified in intervening. Certainly they should have ascertained how far the proposed line would have accorded with the general route of which it was ultimately to form a part. In the contract in question, it had been stipulated, in order to serve some local or passing interest, that the line should run to the village of Dorchester. It was quite uncertain if this location would best conform to the main route. Indeed, as it was afterwards proved, the Intercolonial Railway, in order to serve comparatively insignificant interests, was twisted many miles out of its proper course.

Work to some extent, however, was commenced some time before 1st July, 1867, and, on the 8th of that month, Mr. C. H. Grant, the agent of the contractors, wrote to the Provincial Secretary, announcing that he had arrived at Dorchester to assume his duties, and that he was provided with full powers and instructions to carry on the work.

There appears no record of the extent of the work performed before 1st July, 1867. It is, however, well understood that its value was unimportant.

In July, 1867, on the formation of the first Dominion Government, intimation was given to the Government of New Brunswick, that the proposed Eastern Extension Railway, as the short section in question was then designated, might not be in a proper position to form an eligible section of the Intercolonial Railway, and in October the Minister of Public Works submitted to the Privy Council a memorandum to the effect that certain parties, since the 1st July, 1867, had been engaged in constructing a railway between Moncton and Sackville, in

New Brunswick, with a view to its becoming a portion of the Intercolonial Railway, and that he was doubtful if the location of the line, or the character of the work would be such as to justify the General Government in adopting it as part of the Intercolonial line; he, therefore, recommended that the Government of New Brunswick should be notified that the railway could not be adopted, unless it should be found suitable in location and character: and, therefore, that the work "must be, and continue to be, at the sole cost and risk of the Province."

Upon this notification, the contractors' agent addressed the Minister of Public Works in a letter dated 6th December, 1867, to the effect that the works in question had been commenced early in June, 1866, after eight months had been spent in surveys, and that by the 1st July, 1867, upwards of six miles of grading had been formed, and that at the date of his letter, fourteen miles were completed and all the material for the permanent way provided. He added that the route taken had been prescribed by the New Brunswick Government and by the contract, and that it passed through a most populous and most fertile district. The Provincial Secretary of New Brunswick also declared that the New Brunswick Government would have cancelled the contract at the time of Confederation, if it had been practicable to do so, but that, in reality, the Province was obliged to accept the situation, with the expectation that the Federal Government would accept the line and make provision for refunding the subsidy advanced by the Province.

The Minister of Public Works accordingly instructed the Chief Engineer to examine the railway in question, so that the Government could determine whether or not the transfer should be entertained. Assuming that the point of junction, near Moncton, was suitable, he was instructed to report whether a better alignment could be procured between the point of junction and the termination of his location surveys at the boundary of Nova Scotia. He was also to report the value of the work done and the materials delivered.

[illegible]xamination was made, and the Chief Engineer reported :—

that two lines had been found, both of which passed over lower summits, and were in every respect more favourable, than the line in question; that one of the direct lines was 29½ miles, and the other $27\frac{8}{10}$ miles long, while the line in process of construction by Dorchester was 37¼ miles, or thirty-three per cent. longer than the most direct line. The value of the work executed and materials delivered was ascertained to be less than $80,000, some of which, timber and sleepers, could be moved.

The Chief Engineer pointed out that a great saving, in first cost even, would result by paying the value of the work done on the line under construction, abandoning it wholly, and adopting a direct line. He argued that the railway to connect the several Provinces should not be unnecessarily increased in length, nor its engineering features be made worse than need be; and that in this case the railway would be twisted a long distance out of its proper course without serving any sufficient purpose. The Government of New Brunswick was certainly committed to a contract for work ultimately to be a part of the Intercolonial, which provided that the line should pass a small village of local importance. It was discovered that this contract involved the construction of an unnecessary length of railway, with heavy gradients and objectionable curves; that it would practically place Nova Scotia from eight to ten miles farther from the remaining portions of North America than was necessary, and thus virtually impose a tax of something like one shilling a head, and the same amount per ton, on all passengers and freight passing over the railway, for all time to come.

It is not to be wondered at, therefore, that the Dominion Government were unwilling to accept the unwise contract made by New Brunswick; or that the Engineer of the Dominion should suggest, that it was a matter of absolute economy, to pay for the value of the work done and place the railway in its proper position; and thus, at an expense of less than $80,000, to save the construction and perpetual maintenance of nearly ten miles of line.

The report of the Chief Engineer being made known, several Sena-

[redacted]

The matter, by order in Council * was accordingly referred to the Intercolonial Railway Commissioners, to report on the advisability of adopting the line as a portion of the Intercolonial; farther, to state its money value to the Dominion, taking into account, in case of purchase, the prospective loss in the adoption of the line in preference to the shorter and better route.

The Commissioners recommended that the Dominion Government should offer to New Brunswick, to assume the Eastern Extension Railway, when satisfactorily completed, for the gross sum of $894,000, the New Brunswick Government to settle with the contractors; and that the New Brunswick Government should be notified, that, if this offer was not accepted within sixty days, the Commissioners should be authorized to proceed with the construction of the direct route.

A Minute of Council was passed in accordance with this recommendation, and a notification of it sent to the Lieutenant Governor of New Brunswick.

The contractors' agent, having received a copy of this decision from the Government of New Brunswick, appealed against it, on the ground that the sum offered for the completed railway was insufficient, and begged for a farther consideration.

The New Brunswick Government do not appear to have objected to the Order in Council, but, in communicating the order to the contractors' agent, added, that "in any arrangement for the sum to be paid for "the road, it must be borne in mind, that the amount for which the "Province of New Brunswick is liable, as well as for subsidy as land "damages, under the construction contract, is to be deducted, in order "that the Province may be re-imbursed for any outlay respecting the "road."

The question remained unsettled until the summer of 1869, when it was finally agreed that the railway from Painsec to the boundary of Nova Scotia should be transferred to the Dominion Government for

* 12th March, 1869.

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PLATE No. 1


GENERAL MAP
SHEWING ROUTE OF THE
INTERCOLONIAL RAILWAY
Sandford Fleming, Engr. in-Chief.
ST LAWRENCE
PRINCE EDWARD
CHARLOTTETOWN
STRAIT
ATLANTIC
OCEAN
NOVA SCOTIA

"the Middle line" was the most direct to Halifax, being one mile shorter than the "Interior line" and four miles shorter than the "Shore line;" 3rd. That the "Interior line" was the most direct to St. John, being three miles shorter than the "Middle line" and seventeen miles shorter than the "Shore line"; 4th. That the "Interior line" was the shortest to construct, the length of railway to be built being six miles less than the "Middle line" and ten miles less than the "Shore line;" and 5th. That the "Interior line" would be the cheapest to construct, an estimate of cost being $175,000 less than the "Middle line" and $700,000 less than the "Shore line."

Taking all these facts into consideration the Commissioners reported in favour of the "Interior line" and the Government accordingly adopted it.

The entire line having now been established, the work of construction was proceeded with, the Commissioners managing and controlling the expenditure until the year 1874, when Parliament passed an Act (37 Vic. Cap. 15) vesting all the powers and duties of the Commissioners in the Minister of Public Works.

At the time of the transfer to the department of Public Works, the Intercolonial Railway was in a forward state, the portion between Moncton and Truro and between Rivière du Loup and Trois Pistoles, in all 153 miles, being open for traffic. Since then the works have been carried on, to their present state of completion, directly under the control of the Department.

CHAPTER VII.

THE ENGINEERING CHARACTER OF THE LINE.

Principles of Construction—Climatic effects of frost and thaw on the works—Action on Road bed—Thorough drainage—Clearing the Line—Natural snow fences—Bridges—When bridges should be used—Precautions in building bridges and culverts—Cuttings and their width—Ballast—Iron and Steel Rails—Station buildings—Water supply—Principles of construction concurred in—The "Rail system," or Superstructure—Bessemer Steel Rails—Fish and Scabbard Joints—Cross-ties—Ballasting—The Substructure—Cuttings and Embankments—Drainage—Precautions against frost—Embankments preferable to open bridges—Measurement of streams—Standard designs—Box Culverts—Arch Culverts—Open Culverts—Pipe Culverts—Tunnels—Inclined Culverts—Bridges and Viaducts—Bridge superstructure.

A marked feature of the Report of 1865, was the opinion expressed with regard to the structures and other works throughout the line, and the general engineering features of the Railway, as a whole.

The geographical position of the Railway, and the national character of the work, equally suggested substantial masonry and iron bridges; the estimates accordingly provided for structures of this class. The exigencies of climate were also held to be paramount, calling for a perfect system of drainage, and ballasting, to assure a good and durable road-bed.

The whole character of the Railway was fully considered, and the views expressed were sustained by such argument as the necessities of the case suggested. Much which was then said may now be brought forward, as setting forth the principles, on which it was proposed that the Railway should be constructed.

The climate of Canada has a marked effect on railway works. The frost is very severe; it penetrates the ground, where denuded of snow, to a depth of from three to four feet, occasionally even to a greater depth.

On the slopes of cuttings and embankments, the snow not unfrequently is drifted by the wind so as to leave such spots exposed. On the track itself the deep snow is removed to admit the passage of trains. In all such places the frost penetrates the soil to some distance, and if, owing to the presence of springs, or other causes, water be retained, injurious effects will certainly be experienced from freezing, and the subsequent thaw.

Embankments, when newly formed, retain much of the rain of autumn. During the ensuing winter this moisture is converted into ice, and when the thaw of spring is felt, the material, to the extent the frost has penetrated, is frequently reduced to the consistency of paste. The material has then a tendency to slide and to produce results exacting considerable outlay to restore the work to its original form.

The first winter, with the ensuing spring thaws, is the most trying on new embankments. After the end of the third year, ordinarily the difficulty disappears. It is different with cuttings. In wet soils, time alone will not give stability. Year after year, on the breaking up of winter, certain kinds of earth, impregnated with water, become semi-fluid; in this state they slide and fill up the ditches, sometimes flowing even over the rails. In such cuttings, when proper precautions are not taken to carry off the superfluous water, such results are constantly experienced.

The road-bed itself, even when well ballasted, is not free from disturbance, when the subsoil is permitted to retain water within the frost limit. The rails, consequently, are thrown out of level and alignment, producing an irregularity equally injurious to the rails and to the rolling stock. Wherever the track is in this condition, it is not practicable to maintain the speed of trains, with a due regard to safety.

Such effects are not always confined to cuttings. They are witnessed even on level sections of country, and, in all cases, are attributable to the presence of water and the action of frost. There is but one remedy to meet this condition—thorough drainage. Good ditching to some extent obviates the difficulty, but this remedy is often imperfectly applied.

Any shallow ditch, on a descending grade, will carry the surface water to the extent of its own depth. But this partial result is insufficient. The ditch must be taken below the line penetrated by the frost in the road-bed; otherwise the road-bed will continue to be saturated by moisture, and penetrated by frost, with the effect described. The subsoil, therefore, must also be kept dry by under drains, carried below frost limit. Wherever this work is effectually done, the slopes of cuttings and the road-bed, in all circumstances, will be kept dry and solid.

The clearing of the line also requires attention. In forest land the extent cleared should be of sufficient width to remove all chance of the obstruction of trains, from trees falling across the track, and to reduce the risk of injury from extensive bush fires. The latter contingency is not improbable, especially in the Maritime Provinces where resinous forests prevail. In such cases the flame becomes unmanageable from its magnitude, and, rolling across the track unchecked, it destroys everything combustible in its way, and at times impedes traffic.

The space thus cleared will, in a few years, admit of the growth of a belt of evergreens, to act in winter as a natural snow fence. Should the adjoining lands be cleared of their timber, a snow fence becomes a necessity, and a thick belt of brush would prove extremely effective for that purpose.

No portion of railway work is more important than its bridges When a line is carried out by private effort, a circumscribed capital may compel the adoption of cheap structures. In such cases it is not the character of the structure, or its economy, which commends itself; but it is the necessity of the case, which limits its cost.

A railway constructed to meet a national requirement, and situated like the Intercolonial, is controlled by no such limitation. It requires no argument to establish that in such circumstances all structures should be of the best form suggested by experience, and that the most durable material should be used. They are then permanently built, and require no subsequent renewal. The first expense is the one cost

and in the end, the durable structure is by far the least costly.

These principles clearly establish what the bridges on the Intercolonial line should be, structures marked by no unnecessary expense, substantial, massive and permanent.

Some general rules were laid down to determine the mode in which the large streams and the minor rivers should be crossed. Wherever practicable, an arch culvert for the waterway was introduced with superincumbent embankment. Only in cases where the height of the roadway, above the stream, would not admit an arch, was it considered expedient to employ an open structure, and in all openings, except when capable of being spanned by beams of timber, it was designed that wrought iron girders should be used.

The sizes of the bridges and culverts were not reduced to the narrowest limits. It was held of importance, not only to make full provision for the passage of flood-water, but to keep in view the increased freshet discharge, to be looked for at a future period when the cultivation of the land and the removal of the forest would cause more rapid surface drainage.

Mainly to facilitate the removal of snow from the track, it was designed that the rails should be raised more than ordinarily above the level of the adjoining surface, and that the cuttings should have sufficient width to admit of the snow being cast aside by snow-ploughs. The quantities of excavation submitted were computed on the basis that the cuttings should have generally a width of 30 feet at formation level, with side slopes of one and one-half to one. That average width to be varied in different localities in proportion to the record of snow-fall.

Ballast is an important element in a railway. Much of the durability of the rails, and, indeed, of the rolling stock, depends upon it. The railways which do the most business with the least outlay are, as a rule, found to be the best ballasted ; and the employment of the best ballast obtainable, even at somewhat high cost, was recommended as true economy.

At the time when the report of 1865 was made, steel rails were but

little known, and it was then contemplated to use iron rails, weighing, with the joint fastenings, 70 lbs. per lineal yard. It was pointed out that the iron should be the best manufactured. There is no economy in purchasing low-priced, inferior iron. The charges of shipping, transporting, handling, laying track, and other expenditure, are the same, whatever be the quality of the iron. This point was satisfactorily met, as steel rails were substituted for iron throughout the whole line.

With the exception of the few localities where towns called for extended accommodation, it was held that there was no necessity for much expenditure on station buildings: and it was held to be wholly unnecessary to spend money through the wilderness portions of the line on costly buildings.

The water supply for the engines always exacts consideration, and attention must be directed to provide a frost-proof water service; without it a railway cannot be satisfactorily worked.

A sufficient number of permanent establishments, consisting of engine stables and work-shops, with suitable machinery, for the accommodation and repair of rolling stock, were recommended to be placed at central and convenient points, judiciously selected.

The principles laid down received general assent, and it was recognized that a work of such national importance should be of a high standard.

The report and the estimates were submitted to the Imperial and Provincial Governments, and in the negotiations which followed, these documents, with others of the same import, prepared in London by the Chief Engineer in 1868, formed, in part, the basis of the arrangements by which the Imperial guarantee was given.

On the consolidation of the Dominion in 1867, the location was proceeded with, and it became the duty of the Chief Engineer to prepare designs for the work, and to determine how the accepted principles of construction could be best applied.

It is not necessary to enter into the details of the explorations and surveys, and of the preparation of the working plans, and of the con-

duct of the work for the years it has been in progress; but a description of the railway as it has been carried out, is indispensable to show what its engineering character really is.

It is claimed that unfavorable climatic influences have been guarded against; that the structures are thorough and permanent; and that with regard to the permanent way, when drainage and ballasting are completed as designed, the railway may be classed as second to no work of its kind either on this Continent or in Europe.

A railway of a high standard is in fact a simple problem. It does not exact magnificence of design, or works which astonish by their display or cost. Architectural monuments have no place on public works like the one in question, and many well known structures can be regarded only as mementos of useless expenditure.

As a theory, the perfect railway consists of two parallel lines of continuous rails, uniformly sustained by a firm and slightly elastic support. Bridges and culverts are incidents naturally to be looked for, but never to be introduced, except where absolutely exacted. It is the duty of the Engineer to design and establish them as cheaply as he can, having regard to permanency, and not to convert them into opportunities for display. Taste may even be consulted without any expenditure beyond that required to secure solidity, and the skill of the designer should aim at the attainment of effect with the least extent of adorned material, and strive after the grace of outline to be found in extreme simplicity.

In the Intercolonial Railway it was held better to aim at the realization of this principle, than to advocate the introduction of structures remarkable for their magnitude and ornament, however gratifying to the personal pride of the designer.

The Railway proper may indeed be narrowed to two essential parts.

1. The "rail-system," which may be called "the superstructure," including rails, cross-ties or sleepers, ballast, and everything placed above the permanently firm surface, known as formation level.

2. The "sub-structure," which includes all works required to bring the road bed up to "formation level," on which the rail system is superimposed.

THE SUPERSTRUCTURE.

The Intercolonial Railway has been laid throughout its length with Bessemer steel rails, weighing 57½ lbs. to the yard. This weight is nearly 20 per cent. lighter than the iron rails originally proposed, but owing to the character of the material, the steel rails are in reality stronger and much more durable.

It has been said that to be perfect, a rail track should be continuous, but such a result is not practicable. Rails are manufactured in bars, generally not exceeding 30 feet in length, laid end to end and the continuity is broken where the joints occur.

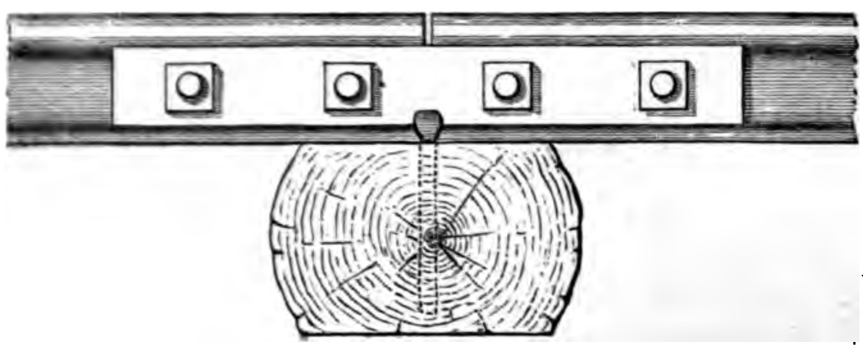


Fig. 1.

These frequent joints constitute one of the defects to be guarded against. On the Intercolonial Railway, two expedients have been adopted, to overcome it; one the ordinary fish joint, Figs. 1 and 2; the other what is known as the scabbard joint. The former is l-known contrivance for

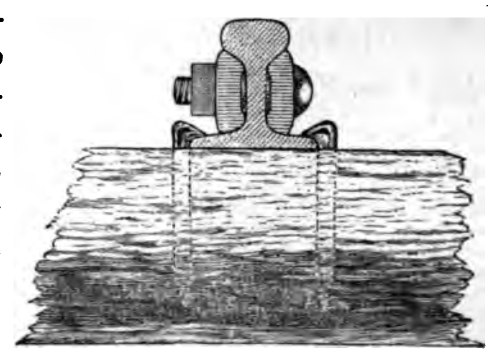


Fig. 2.

keeping the ends uniform in line and level. The fish-plates lie between the flange and head of the rail, and are only 2½ inches deep. As they have to endure the strain of passing trains, the rigidity of the joint is inferior to that of the rail, the latter having a larger sectional area and a depth of 4¼ inches. The ordinary fish-plates do not, therefore, give perfectly unyielding joints.

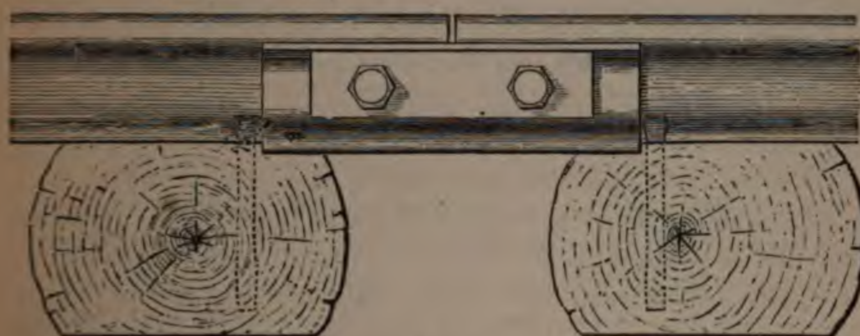


Fig. 3.

Fig. 4.

The scabbard-joint, Figs. 3 and 4, is more rigid, inasmuch as it makes a steel beam, 3½ inches deep, instead of 2½, has a greater mass of metal, better distributed; and is more simple, having fewer parts. The scabbard when properly made of good steel, is undoubtedly the best splice known for rails, and severe tests go to prove that, of all fastenings, it makes a joint approaching the most nearly in strength that of the mid-section of rail. In effect, it renders the rails composing the track, approximately continuous.

The rails are spiked to cross-ties or sleepers, 6 in. thick by 8 in. on the face, laid on an average 2 feet 6 in. from centre to centre. They are invariably of the best description of timber procurable in the dis-

tricts traversed, and generally consist of Black Spruce, Prince's pine, Tamarac and Cedar.

A substance, not too rigid, is needed to furnish a bed for the cross-ties: this is designated ballast. It lies as a cushion on the road-bed, and gives to the rail system a slight and uniform elasticity. The quality of the material for ballast is important. Gravel, the material generally employed, if mixed with clay or light loamy sand that will hold water, is unsuitable and should not be used. A coating of such unsuitable material is even injurious, as it simply elevates the road-bed, and has the effect of narrowing the space for proper ballast. The embankments are 18 feet wide at formation level. If a coating 12 in. thick be added, the side slopes being 1½ to 1, the width of the ballast bed is reduced to 15 feet, and it thus becomes necessary to widen the embankment when proper ballast is laid down. The use of improper ballast, results in the premature destruction of rails and rolling stock, while the longer life attainable by both on a well ballasted line, establishes the necessity for the use of material of the best quality.

THE SUB-STRUCTURE.

Everything which goes to form the foundation for the rail-system may be called the substructure.

When a level tract of country is not intercepted by streams, no necessity presents itself for openings through or across the railway. We then have the most favorable conditions for construction, and it is necessary only to form a light embankment, two or three feet in height, brought up a trifle above the ordinary level of the snow, the material being taken from two parallel side ditches, Fig. 5.

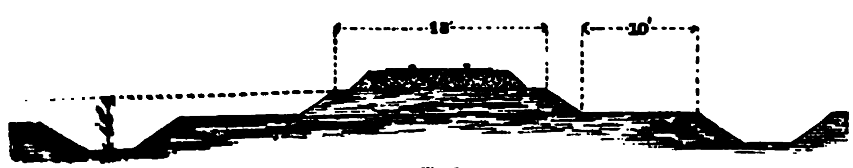


Fig. 5.

It is rarely that conditions so favorable are met. On the Intercolonial Railway they are the exception. Although in limited localities the line traverses ground approximately flat, the natural drainage of the country and provision for freshet discharge, generally rendered openings through the railway indispensable, even in these localities.

The railway passes over several ranges of elevated water-sheds and numerous subsidiary ridges, separating the river systems which it crosses. In traversing a long extent of country with a surface so diversified, cuttings and embankments of all depths and heights are unavoidable; and nearly every variety of soil and rock is to be met. Where embankments are necessary, they have generally been formed of a uniform width of 18 feet at formation level, with slopes generally of $1\frac{1}{2}$ to 1. In some cases the natural slope which the material has taken is not in accordance with this proportion. The maximum height of embankment on the whole line is 110 feet.

The original intention was to form cuttings of more than the usual width, for the purpose of securing ample drainage, and to afford

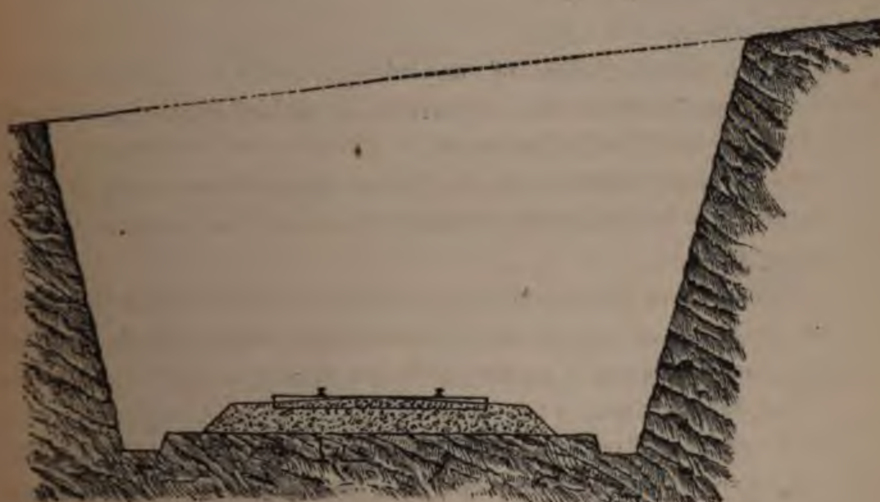


Fig. 6.
EXCAVATION IN ROCK.

facility for keeping the track clear of snow. With a view to avoid expense, this proposition was not entertained; and generally the width is but 22 feet at formation level. There are exceptions, however, where the width is greater. The side slopes in rock are 0.25 horizontal to 1 perpendicular, as in Fig. 6; in ordinary earth 1½ horizontal to 1 perpendicular; but in some wet clay cuttings, slopes of 2 to 1 were found necessary.

It has been stated that the frost penetrates the ground to a great depth, and as a consequence wherever the soil is at all wet, the thaw disturbs the road-bed and injuriously affects the earthworks. Special care was consequently directed to drainage. Fig. 7, illustrates the plan adopted in the formation of underdrains: they are placed, as a rule, immediately at the foot of slopes; formed with drain pipes and the trenches filled with ballast to within a foot of the surface. In rock cuttings, provision was made for carrying off the water by shallow trenches on both sides, as shown in figure 6, so as to keep the track perfectly dry.

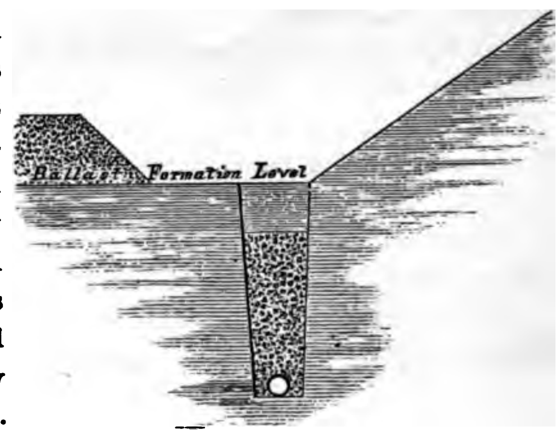


Fig. 7.

Fig. 8 is a cross section of the ordinary cutting, 22 feet wide at formation level. It shows the underdrains below the frost limit, so that water to a depth of at least four feet will be carried off, and the road-bed kept dry and free from the effects of frost. When such cuttings are subjected to the effects of the maximum snow-fall, as is indicated on the diagram, the operation of the railway becomes difficult. A large expenditure, either in removing the snow, or in roofing the cuttings, may be looked for.

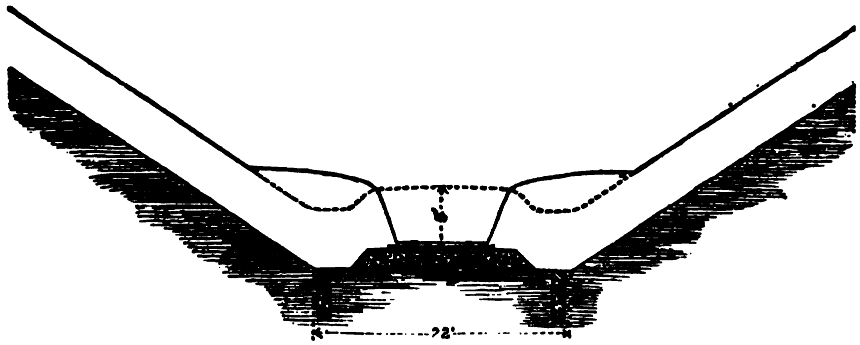


Fig. 8.

It is to be regretted that the cuttings were not formed on the principle shown by Fig. 9. The deep side ditches would have fulfilled

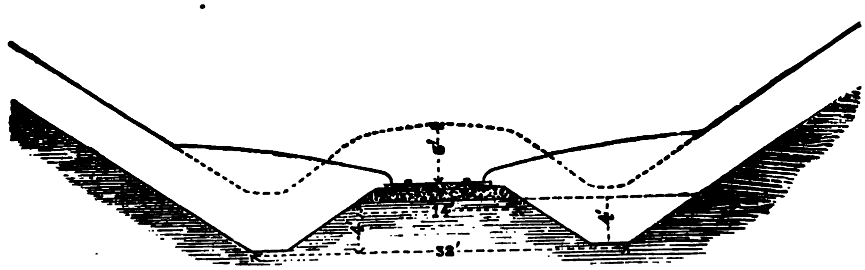


Fig. 9.

the duty of underdrains in keeping the road-bed dry and free from disturbance by frost, and at the same time would have afforded space to receive the snow thrown off by the snow plough. The increased width would have enhanced the cost to a less extent than was assumed by the opponents of the principle, as the extra width in many cases would have provided material for embankments, where, the narrower cuttings being insufficient, borrowing pits had to be resorted to. It is also estimated that cuttings of the larger form referred to, would have entailed less additional cost than the erection of snow sheds. Besides, wide cuttings are preferable; as in themselves the snow sheds being perishable, and from time to time requiring renewal, are always exposed to destruction by fire.

Structures for the passage of water, whether of rivers or less important streams, should never be lightly considered. One of the leading principles observed, was to create as few bridge openings as possible. Whenever practicable to pass a stream through a covered passage in the continuous embankment, that system was followed. The same principle governed in carrying the line across valleys. It was held that no viaducts should be introduced; that as an engineering question, an earthern embankment is preferable. A calculation of the comparative cost, proved that of the two, under ordinary circumstances, where the height does not exceed 80 feet, the embankment is the cheaper, and that in some exceptional cases, embankments of a greater height may be with economy employed.

Open bridges were, therefore, strictly confined, with a single exception,* to the large river crossings.

So little was known, at this period, of the country through which the Intercolonial Railway now runs, that it was difficult to establish in each case the requirements of waterway and the other conditions to be observed. In settlements, information of some kind may be obtained, but the country to be traversed was for a great extent a wilderness, and few data of any kind were known concerning it.

In each case reliable information had to be gathered in order that the size and character of structure might be determined. A structure conceived on a scale unnecessarily large calls for a useless expenditure of money. If too cramped in size, annually during floods it will be exposed to the risk of being carried away. Ultimate destruction is generally its fate, and when this contingency arises, even if no loss of life results, the money expended in reconstruction may be held as so much dead loss. Any miscalculation with regard to the size or character of a structure generally results in uncalled-for expense, and it is therefore necessary clearly to determine what the true requirements in each case are.

Assistants were accordingly detailed to measure the streams during

* Folly River Viaduct.

the periods of maximum discharge; to ascertain the sectional area, velocity and volume, when the freshets from the melted snows were at their height. This information was tested by repeated observations; and the number and sectional area of all openings for the passage of water was determined in accordance with it. To the sectional area thus ascertained was added a marginal allowance for floods of more than ordinary occurrence.

The precise character of each individual work next became the subject of consideration.

It was deemed advisable to reduce the plans to a limited number of classes; to adopt designs of the simplest type; and to prepare standard working drawings, which would suit ordinary cases, and which could readily be adapted to any peculiar necessity. They were as follows:—

1. Box culverts.
2. Arch culverts.
3. Open culverts.
4. Pipe culverts.
5. Tunnels.
6. Inclined culverts.
7. Bridges and viaducts.

Many of the structures embraced in this classification are remarkable only for their number. Nevertheless the description of the railway would be incomplete, without mention of them.

1. Box Culverts.

These culverts were designed to carry off runs of water, or for places where an outlet for surface drainage across the line was necessary.

They ranged from two feet to six feet in width, and from two feet to nine feet in height, but the prevailing size was two feet or two feet six inches in width by four feet high. Fig. 10 is a cross section of the

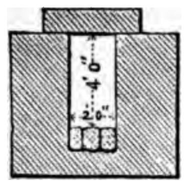


Fig. 10.

commonly occurring size. It was deemed advisable to adopt four feet as the standard height for the smaller culverts, so that a man could pass through to repair or clean them out.

Few culverts have been constructed of less height than four feet, although occasionally where the road-bed was low, culverts two feet six inches square have been introduced.

As some quarries furnished large flat stones, adapted for this character of work, and other quarries supplied material better fitted for the arch, it was an object to accommodate the designs to such circumstances

Box Culverts, of various sizes ranging up to six feet in width by nine feet in height, were used when it was advantageous to do so. Figs. 11 and 12 are cross sections of medium sized box culverts, the water-way of the one three feet wide, by four feet six inches high, that of the other four feet wide by six feet high. Figs. 13 and 14 indicate

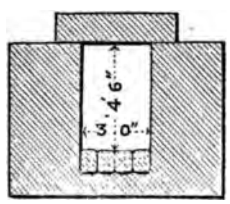


Fig. 11.

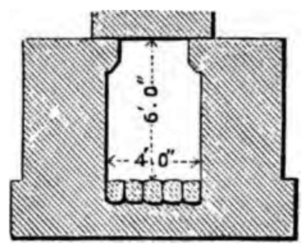


Fig. 12.

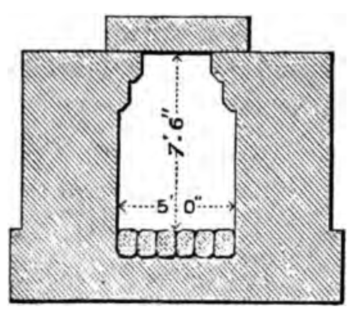


Fig. 13.

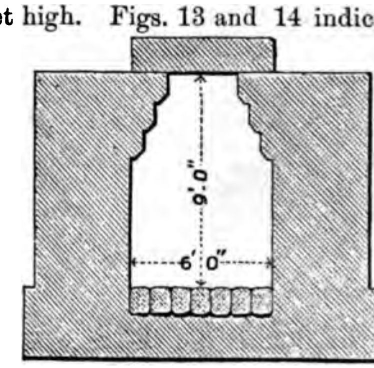


Fig. 14.

the proportions of the largest sizes built, the water-way of the one being five feet by seven feet six inches, and the clear opening of the other

being six feet wide by nine feet high. These sections show the manner in which structures of this class, over three feet in width, had their walls corbelled, in order to carry the massive covering stones required.

These large box culverts were introduced only when the material available was unusually strong and massive. The ends of all culverts of this class were of a simple design, as in Fig. 15; they were usually placed square to the body of the work, with deep apron walls to prevent any undermining by the stream or upheaval by frost.

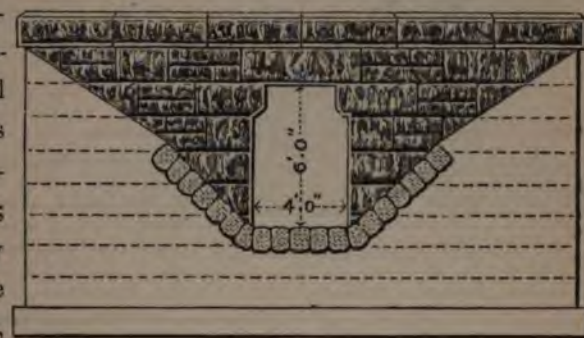


Fig. 15.

2. ARCH CULVERTS.

The arch culvert was designed for streams requiring a clear width of water-way from 4 feet to 20 feet and upwards; and when the embankment through which they passed was of sufficient height to admit the turning of the arch.

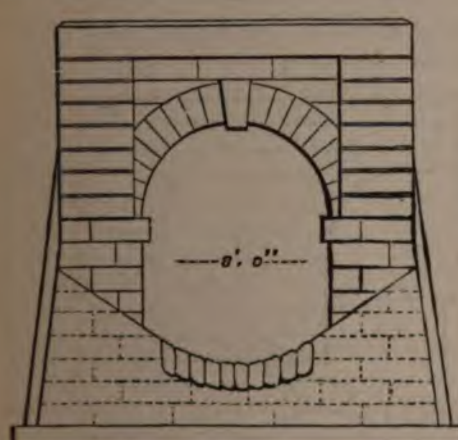


Fig. 16.

With some modifications to suit local circumstances, they were all made after one type. The lower, or downstream end, is shown by Figs. 16 and 17; the former being an elevation and the latter a longitudinal section. The upstream end is formed with cross wall to obviate the possibility of the current finding a passage behind the masonry.

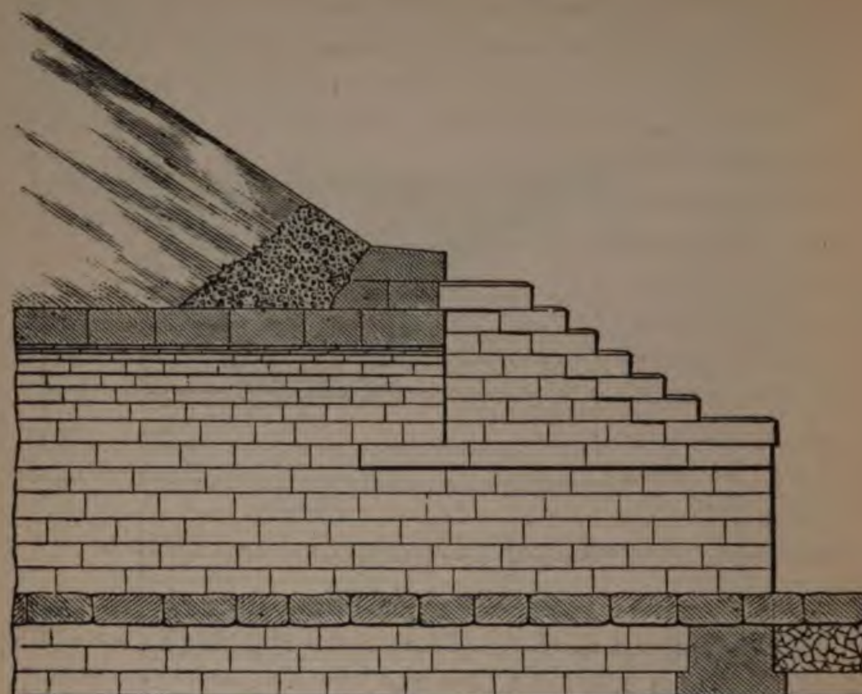


Fig. 17.

Fig. 18 represents an elevation of the up-stream end of this culvert, and Fig. 19 is a longitudinal section. The parapet walls, indeed exposed walls in all structures, were directed to be backed with a quan-

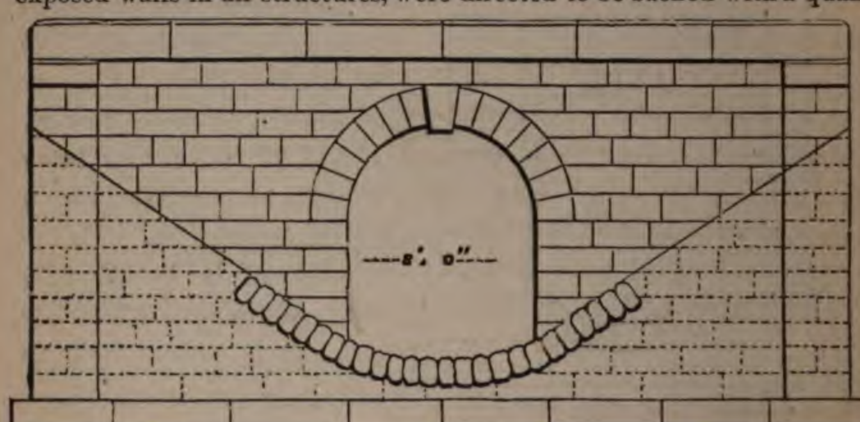


Fig. 18.

tity of small rip-rap or broken stone, as indicated in Fig. 17 and 19, to prevent injury from frost. Particular attention was paid to the foun-

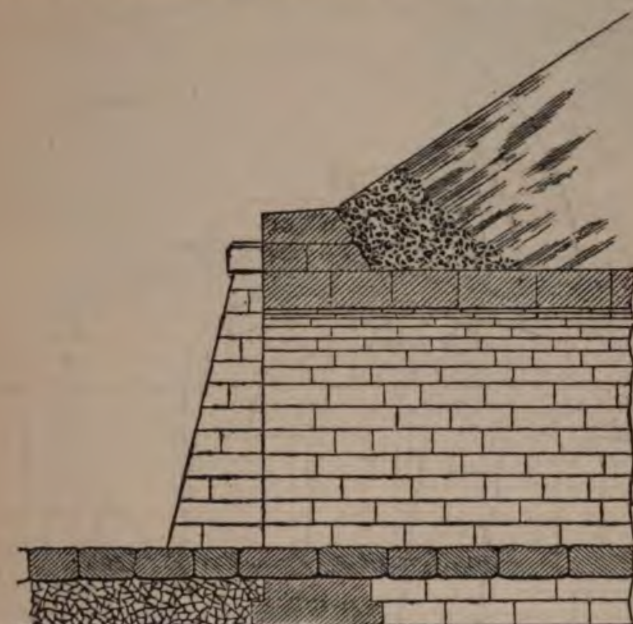


Fig. 19.

dations; in all cases where the natural sub-stratum seemed at all doubtful, artificial foundations were obtained by piles, concrete and other means.

Drawings were prepared for ten different sizes, with arches from 4 to 20 feet diameter, cross-sections of which are shown by Fig. 20. Every horizontal and vertical dimension was proportioned to the size of the arch. The length only varied according to the height of the superincumbent embankment. And to prevent mistakes in setting out the work in the field, tables of lengths above and below the centre line were prepared, by which culverts of any size, in any embankment on the line, could be laid off with accuracy.

Only at one point has an arch of more than 20 feet been introduced; and special drawings were then prepared. In Fig. 20 are represented

cross sections, of the various arch culverts up to 20 feet span, which have been built on the line.

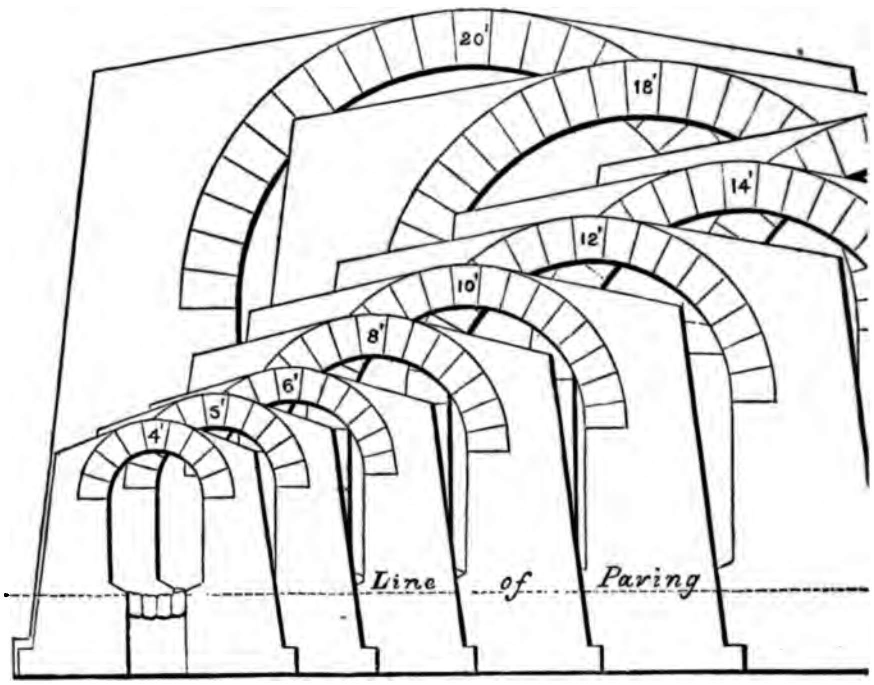


Fig. 20.

3. OPEN CULVERTS.

As already mentioned, a decided preference was given to covered structures for the passage of streams; and they were adopted whenever practicable. There were cases, however, when, owing to the width of streams, or insufficient height of embankment, a covered passage could not be obtained. In all such cases the streams had to be spanned by open structures, which were formed of beams or girders placed on walls of masonry. Open structures above 20 feet span were termed bridges; when of less than 20 feet span, they were accounted open or beam culverts. Fig. 21 is a type of the open culvert. It consists essentially of

two masonry abutments, proportioned to the height of the embankment, sufficiently far apart to allow a passage for the stream, and on which

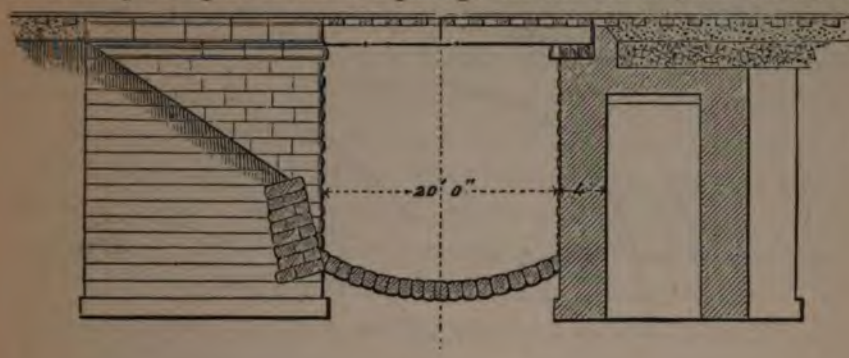


Fig. 21.

rests the rail system, supported on beams stretching from abutment to abutment. In open culverts of small span the beams are single under each rail; in the larger spans they are double and set side by side. The great majority of structures of this class do not exceed 10 feet span and are invariably in shallow embankments. For reasons given, the introduction of the large size was studiously avoided; the number on the line is consequently limited. The figure shows an open culvert of 20 feet span, in an embankment 20 feet high; this is the largest size. In cases where the embankment exceeded 20 feet in height, and the stream required the width, arches of 20 feet span were substituted.

4. PIPE CULVERTS.

In localities where building material could not be obtained without difficulty, it was found advantageous to employ cast iron pipes or cylinders. These pipes were of cast iron three feet in diameter, with spigot and faucet joints. Culverts of this class were advantageously introduced on sections of the line near tide-water, where the iron cylinders could be brought by sea-going vessels. They were quickly and economically made, the two ends were encased in masonry; the body of the culvert consisted of a sufficient number of iron pipes to reach across the embankment, the castings being of different lengths. The pipes were

bedded and completely encased, to a minimum thickness of nine inches, in hydraulic cement concrete.

There can be no question with regard to the durability of this class of structure. The chemical affinity between cement and iron is such, that the concrete becomes as hard as stone and will alone be sufficient to resist the pressure of the embankment and all wear and tear, even should the iron lining be removed by oxidation: a contingency not to be looked for, except after a long interval of time. Pipe culverts were introduced in all situations, but they were found more especially useful in side-hill ground, where structures of the 6th class were called for. Fig. 22 illustrates the lower portion of a pipe culvert on side-hill.

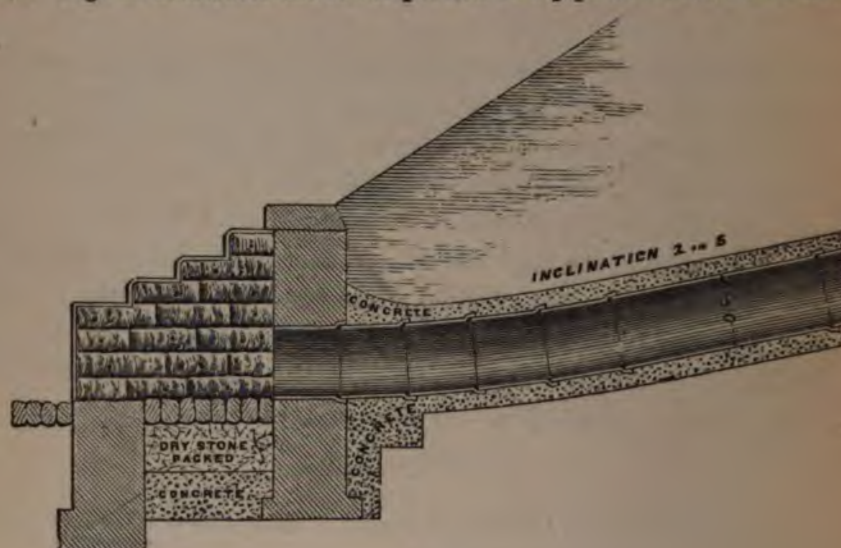


Fig. 22.

5. TUNNELS.

Where streams crossed the railway in deep rocky ravines, it was frequently found preferable, as a matter of convenience and economy instead of spanning the ravine by a bridge or constructing a culvert, to pierce one side of the ravine by a tunnel, through which the stream could be diverted, and to form a solid embankment across the channel

of the stream itself. This expedient was adopted, not only in deep ravines, but in other localities. Figs. 23 and 24 show a section and plan

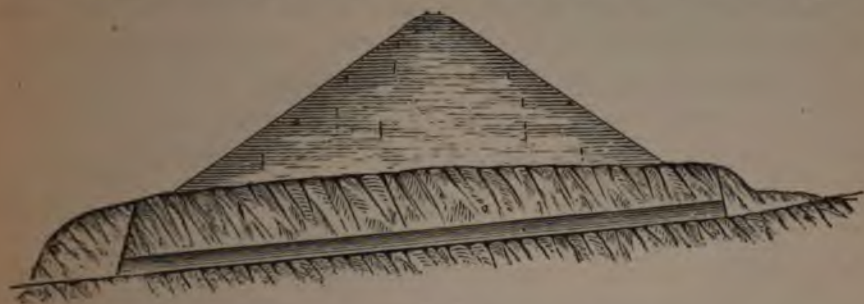


Fig. 23.

of a tunnel, which was formed at one point on the line under an embankment exceeding 100 feet in height. The whole work, including

Fig. 24.

the embankment, was completed at less cost than a bridge, or even a culvert with the superincumbent embankment. The one condition necessary, was the presence of rock of sufficient solidity and durability. They have been used in cases where the rock was of a nature requiring to be lined with masonry; as in the perishable Sandstones, along some parts of the Bay of Fundy. In all cases they brought into play a cheap description of labour in their construction, and allowed the formation of the roadway to be proceeded with, much sooner than

would have been possible, had structures of masonry been carried out.

On side-hill ground, such as occurred in passing over the Cobequid mountains in Nova Scotia, small tunnels were frequently introduced, they are shown in Fig. 25.

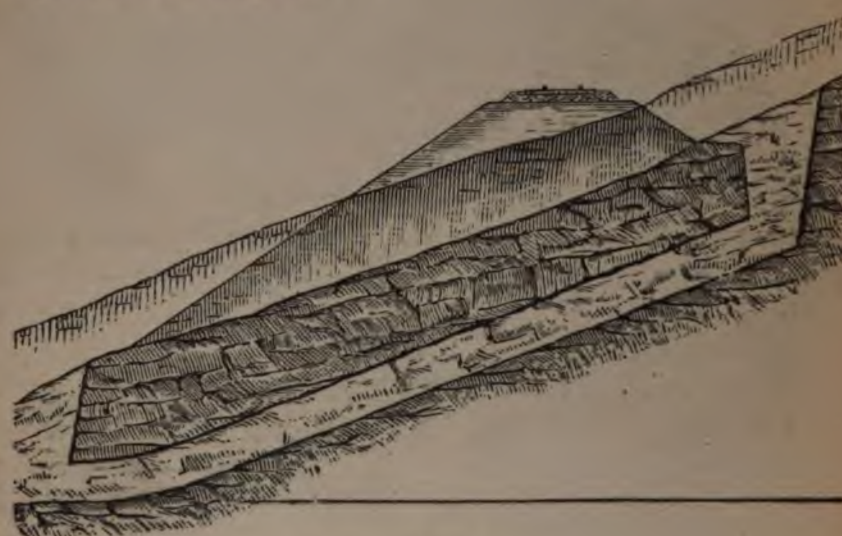


Fig. 25.

6. INCLINED CULVERTS.

The designs for structures of the 1st and 2d class were applicable where streams flowed in channels with little fall; but on side hills, where the streams often become swollen torrents, it was necessary to adopt means to prevent the possibility of destruction of the structure.

Ordinary culverts were employed in all cases where the fall of the stream did not exceed, on an average, one foot in twenty. With streams of a greater fall, the structures employed, came under the designation "Inclined Culverts," and in all such cases special designs were prepared. Inclined culverts were built of both Box and Arch work: Fig. 26 shows the mode adopted for arches.

In both cases the walls were regularly stepped, to insure stability:

and precautions were taken to prevent the water of the stream from finding a way underneath the paving or below the walls.

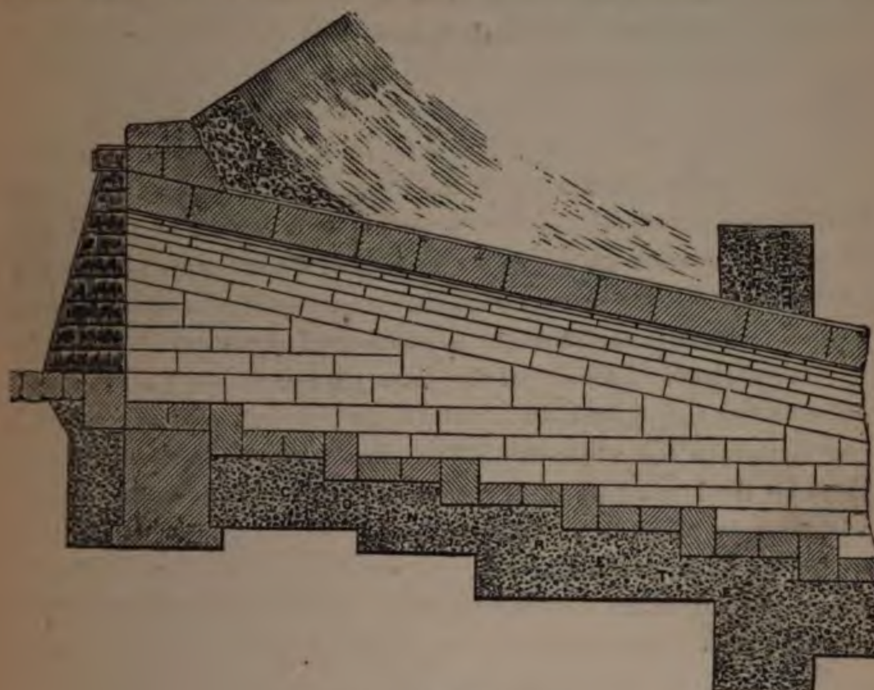


Fig. 28.

The line of paving was placed considerably lower than the natural bed of the stream; the whole masonry was laid in cement; and the walls at the upper end were built in such a way as to be impervious to water.

To increase the security of the work, a concrete wall was formed underneath and around the body of the culvert, midway between the two ends; and this wall was made perfectly water-tight, across the ravine in which the culvert was built. The footings of walls were full bedded in cement, and the spaces underneath the paving and around the walls were filled with concrete. The paving was all laid in cement.

Other precautions were taken to render the work secure. In cases where the walls could not be founded on rock, the lower ends had a deep set apron wall, with wing walls and a secondary front wall also deep set. Above and around the whole, loose stone filling, "rip-rap," was placed, to deaden the effects of the stream rushing rapidly down the smooth surface of the culvert. These and other precautions were adopted as the circumstances of each individual case seemed to dictate, in order to secure permanence in the work. Fig. 26, represents a longitudinal section of the up-stream portion of a culvert of this class. Here the wing walls are square to the body of the structure : but at the down-stream end, the arrangement shown on Fig. 22 was generally carried out, with such modifications as each case necessitated.

It has already been stated that iron pipes were used for inclined culverts, but they were only introduced to carry off streams requiring less than three feet water-way. The pipes were cast in short lengths, those for the lower part of the culvert having radiant ends, so that, when set in place, they would lie in a curve as in Fig. 22. By this means the water descending through the culvert with great velocity, would be changed in its direction and discharged horizontally, thus reducing the tendency to undermine the lower end of the structure.

7. Bridges and Viaducts.

This class includes all structures with clear openings exceeding 20 feet. On the Intercolonial Railway, the spans range from 24 feet, the *minimum*, to 200 feet, the *maximum*.

It has already been stated that a viaduct is not, under ordinary circumstances, an economical or desirable structure ; and that it should only be introduced where a river of considerable width has to be crossed. Accordingly Bridges have been avoided in all cases, where a solid earthen embankment could be formed. The one exception, at the River Folly in Nova Scotia, has already been mentioned.

The number and length of spans, and, to some extent, the form of ᵗe superstructure of a bridge, depend on the width of the river at

flood, the character of the river bed, the formation and movement of ice, and the quantity of drift timber which may be looked for. It was not found necessary in any case to have wider openings between the piers than 200 feet, and although in many instances several openings occur in the same structure, it was only considered expedient to adopt spans so great in three bridges. Wherever the cost of founding piers was not excessive, spans not exceeding 100 feet were used; and in every instance where the character of the river would admit with safety the employment of spans shorter than 100 feet, they were adopted.

In laying down general principles by which the construction of the whole of the structures on the line was to be governed, engineering requirements were primarily regarded; but economy in expenditure was by no means lost sight of. It was felt that while the abutments and piers should be designed to efficiently resist the peculiar climatic forces to which they would be exposed, it was equally important to accomplish the desired object at a minimum cost. A saving of expenditure at one point, or on a single structure, might be a matter of no great consequence, but when multiplied by the number of cases which occur on such a length of line, the importance of a well-considered system becomes apparent.

The question is governed by several considerations, the most important of which is the difference between skilled and unskilled labour. The Engineer determined that iron should be used instead of wood in the spans of bridges, on account of its durability, but he also considered that there should be as few bridges as possible, for reasons already submitted; and from the consideration that the iron work had to be imported; and, being the product of skilled labour, more costly than ordinary earth or stone work executed in the locality. Again, as masonry, is likewise the product of skilled labour and costs for a given quantity, fifty times as much as earthwork, it should in consequence be used sparingly, in fact never introduced where the latter can be substituted: moreover, it was held that none but the best masonry should be admitted and that a limited quantity of good masonry could in

most cases be employed more advantageously than a larger quantity of inferior masonry; that the difference in cost between equal quantities of both kinds was limited, and no way in comparison to the greater degree of stability and permanency attained by the use of masonry of the first quality.

In designing the Piers, their exposure to ice and drift-wood rendered it necessary to make them massive and of a form which would enable them to resist any shock. It would be no economy to make them otherwise. But in the form of the abutments, it was found that strength, durability, and the principles of economy referred to, could be consulted at one and the same time.

The plan of abutment adopted, consisted simply of a hollow tower

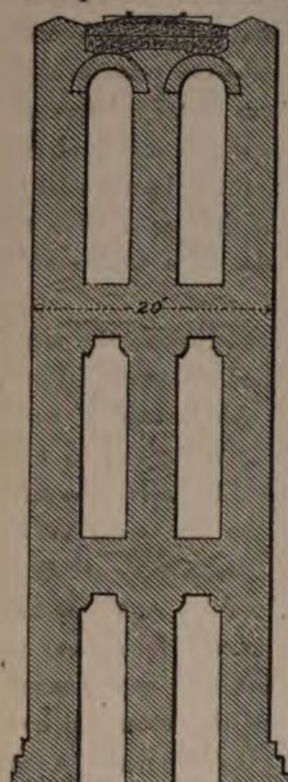


Fig. 27.

Fig. 28.

of no greater width than was required for the support of the superstructure, and built perpendicularly on the four sides. The sections Figs. 27 and 28 give the form of tower as it has been built; in some cases with two rectangular cells as in Figs. 27 and 29; in others, the void was made circular as in Figs. 28 and 30; and in both cases the voids were corbelled or arched at the top to support the ballast and rail system.

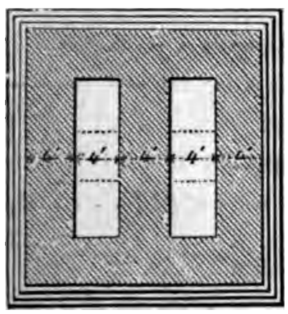


Fig. 29.

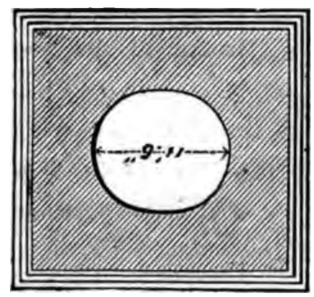


Fig. 30.

A comparison between the cost of this form of abutment and the plan commonly carried into execution on Railways previously constructed, may be advantageously made.

Abutments have usually been built with wings, necessarily heavy, in order to resist the pressure of the embankments.

Taking four different designs carried into execution on the Grand Trunk Railway, with the formation level 60 feet high, the quantity of masonry in each abutment is as follows:—

Design No. 1	3230	Cubic Yards.
" 2	2060	"
" 3	2260	"
" 4	2310	"

Giving an average of 2465 cubic yards for each abutment.

As the difference is almost wholly in the form of abutment, it is

not necessary to take into the calculation the intermediate piers, when a comparison of cost is made.

The two estimates of cost stand thus:—

(1) In the Intercolonial Railway system:—			
2180 cubic yards of masonry in the pair of land piers and towers - - - - - - - - - - -	at $13 - -		$28,340
2 sixty feet iron girders erected - - - - -		$ 3,834	
Less 12000 cubic yards of embankment, saved - - - at 30 cents - - - - - -		3,600	234
			$28,574
(2) In the Winged Abutment system:—			
4930 cubic yards of masonry - - - - - -	at $13 - - - -		64,090
Difference in favour of the new system			$35,516

It will thus be apparent that the saving effected is large; it amounts indeed to fully fifty per cent. of the cost of both abutments constructed on the old plan. The estimate indicates the saving in one bridge only.

But economy in first cost is not the only or main advantage. It is well known that winged abutments, even if built sufficiently massive to resist the thrust of embankment, are frequently injured and ultimately destroyed through another agency. If the embankment be formed of any material that will hold moisture, the low temperature of winter is certain to act injuriously upon it. The moist clay or earth behind the masonry becomes frozen solid, and in obedience to the expansive powers of frost, produces an irresistible thrust on the masonry, which, whatever its strength, will eventually become fractured and displaced.

This destructive agent, acting year after year, will sooner or later render reconstruction a necessity.

This effect can never take place with the bridge abutments of the Intercolonial Railway. It is impossible for the hollow towers, placed

in the hearts of the embankments to be rent asunder, or in any way injured, either by the thrust of the earth or by frost. The pressure is at all times external, and being nearly uniform from all sides, no destructive effects can result.

It is not claimed that there is anything remarkable or novel in the peculiar kind of abutment described; but it is held that the principles of construction observed show a due regard to economy as well as to engineering requirements and climatic conditions.

Fig. 31 represents an abutment of moderate height before its

Fig. 31.

connection with the embankment. It also shows a common form of pier adopted in cases where the structure is opposed to running ice.

The superstructure of three of the bridges viz.:—at River du Loup, Isle Verte and Missiguash are of wood. These were erected, under the protest of the chief engineer, by direction of the Commissioners

before their policy on this question was reversed. All the other bridges on the line have iron superstructures; three of the latter viz:—the Restigouche and the two Miramichi bridges, are "pin connection" trusses, constructed by a Philadelphia firm, Messrs. Clarke, Reeves & Co. All the others are "plate" or "lattice" girders erected in place by an English firm, The Fairbairn Engineering Company.

CHAPTER VIII.

THE ST. LAWRENCE DISTRICT.

General Features of the Line—Greatest Altitude—Geographical Divisions—The Four Districts—The Engineering Staff—The St. Lawrence District—General Description—Crossing the Height of Land—Geology of the District—The River Systems—Division A, Contract No. 1—Division B, Contract No. 2—Division C, Contract No. 5—Division D, Contract No. 8—Division E, Contract No. 13—Division F, Contract No. 14.

The Railway extends for 178 miles in the Province of Quebec. Crossing into New Brunswick at the river Restigouche, the distance in that Province is 241½ miles. At the river Missiguash it passes into Nova Scotia, to terminate at Truro, a distance of 80 miles; joining at that place, the line constructed previous to Confederation between Truro and Halifax.

The greatest altitude reached by the line is in the Province of Quebec. This is at Lake Malfait, 108 miles from River du Loup, and 743 feet above the sea. Nova Scotia ranks second to Quebec in respect of altitude, a height of 610 feet above the sea being attained at Folly Lake, in the Cobequid Mountains, 24 miles west of Truro: while the highest elevation in New Brunswick, 514 feet, is at Bartibogue, about mid-way between Bathurst and Miramichi.

At the river Restigouche, the boundary between Quebec and New Brunswick, and at the river Missiguash, the boundary of Nova Scotia, the railway is but little above tide-water; at the former, less than 40 feet; and at the latter, less than 10 feet. The levels near the extreme ends of the line—Truro and River du Loup—are not high; consequently, the line is divided, geographically, into three main ridges—one in each province. The ridges may be described as being 180, 240 and

80 miles broad, rising respectively to 743, 514 and 610 feet above the sea.

During construction it was found convenient to divide the Line into four Districts, which were again sub-divided into 25 Divisions designated by the letters of the alphabet, beginning with A at River du Loup and ending with Z next to Truro. The Districts were called the St. Lawrence, the Restigouche, the Miramichi and the Nova Scotia.

The Restigouche District embraced seven Divisions, each of the other three embraced six Divisions. The lengths were as follows:

St. Lawrence District,	129½	Miles.
Restigouche "	128	"
Miramichi "	117¼	"
Nova Scotia "	124¾	"
Total,	499½	"

These four sections were each placed under a District Engineer responsible directly to the Engineer-in-Chief. Resident Engineers were appointed to each separate Division, who acted under the Engineer of the District; and the latter again had their necessary assistants. The work on each Division was carried on under a distinct contract.

THE ST. LAWRENCE DISTRICT extends from River du Loup along the shore of the St. Lawrence as far as Little Metis, where the line turns in a southerly direction to cross the highlands, dividing the waters flowing into the St. Lawrence from those flowing into the Bay Chaleur by the Metapedia, a tributary of the Restigouche. Its length is 129½ miles and it embraces the following Divisions:

Division A,	Contract No.	1	20	miles long
" B,	"	2	20	"
" C,	"	5	26	"
" D,	"	8	20½	"

Division E,	Contract No. 13	. . . . .	20½	"
" F,	" 14	. . . . .	22½	"
	Total length,	. . . .	129½	miles.

For 90 miles the railway lies within a short distance of the St. Lawrence, in no place more than three miles from it. An irregular highland range extending, with but very few breaks, from River du Loup to Gaspé, dictated this location. Attempts were made to find a location further inland, but the country was rough ; consequently, construction would have been expensive and the gradients steep. Along these first ninety miles the country is closely settled: besides the numerous farm-houses which assume the appearance of a continuous straggling village, there are several towns and villages, as River du Loup, Isle Verte, Trois Pistoles, St. Simon, St. Fabien, Bic, Rimouski, St. Luce, St. Flavie, and Metis.

The most favorable point for crossing the Mountain range occurs near Metis, where a depression is found in the summit, 743 feet above the sea, at a distance, on a straight line from the St Lawrence, of about 20 miles. There is, also, at a distance of 6 miles from the St. Lawrence, an intermediate summit, 561 feet high, on a ridge overlooking the river. The country, on this mountain range is rough and rocky, and many curves are accordingly introduced, the grades being also steep. But, after descending the Southern slope, the flat country along the shore of Lake Metapedia is met, which extends to the end of the District.

There is a considerable area of good land near Lake Metapedia. It is estimated that a belt ten miles broad, in this quarter, contains 130,000 acres of good farming land.

The rock formation of the St Lawrence District belongs principally to the Lauzon division of the Quebec group ; the geological position of which is about the middle of the Silurian System. This group extends in the form of a belt parallel to the St Lawrence, terminating in the Gaspé peninsula.

The Lauzon division is of considerable breadth, west of River du Loup, but contracts to a few miles, at Rimouski. Small outliers of the Sillery sandstone occur in this distance, one of which is met about two miles below River du Loup, and another extends between Cacouna and River Isle Verte.

Interstratified with the shales of the Lauzon division, grey sandstone and limestone conglomerates occur at Trois Pistoles, Bic and Grand Metis. The conglomerates are coarse, and consist of a sandy matrix with pebbles of white quartz and masses of limestone and diorite.

Between Rimouski and Great Metis the railway crosses a small basin of the Sillery limestone.

Near Lake Metapedia conglomerates again occur associated with shales; along the shore of the Lake, the rocks consist of limestone, sandstone shales, and diorite, with an occasional trap dyke.

From these various rocks the building material for the heavy masonry on the district was obtained.

The Rivers flowing into the St Lawrence, although of no great length, yet rising, as they do, in the neighboring highlands, at times discharge a great body of water. On all there is enormous water power from falls and rapids, easily made available, though hitherto but little used. At River du Loup there are three natural falls, one 100 feet high, and two about 20 feet high, almost quite unused. At the mouth of the River the water power gained by an artificial fall drives a large flour mill, and likewise the works of a foundry and machine-shop.

The District Engineer, until the close of the work, was Mr. Samuel Hazlewood, who assisted in the exploratory survey of 1864, and the location surveys of 1868–69.

DIVISION A.

CONTRACT NO. 1.

This Division, generally, is comparatively level; it traverses the table-land or terrace between the St. Lawrence and the elevated range which rises at no great distance from the line. The works are generally light, consisting of low embankments to raise the road-bed above the ordinary snow level. There are only two rock cuttings of importance, and these are near the western end. For four miles the railway passes over tracts of bog, some low-lying, with peat only a few feet deep, others lying higher, with growing peat, 20 or 30 feet deep. No difficulty attended the formation of the road-bed, the low embankments being composed of peat taken from side ditches, generally 15 or 20 feet from the embankments. The matted roots of brushwood and scrub spruce, together with moss and peaty material, formed embankments sufficiently tenacious. Although there was a slight sinking in some places, there was no breaking up of the surface, and the roadway is firm, though elastic. The surface in such cases is covered with a layer of gravelly sand about six inches thick, as a protection against fire.

The culverts on this section are unimportant, there being only three over eight feet span, two of which are twelve feet. There are three bridges, one with a span of 30 feet over the Temiscouata road, one of three spans built over the River du Loup, and the third of two spans built over the River Isle Verte. That over the Temiscouata road is close to that over the Du Loup, and may be considered as constituting parts of one bridge, the western abutment of the river bridge being the eastern abutment of the road bridge. The river bridge is on a skew, but the eastern abutment of it is on the square. The foundation is rock, on the bed of the river; and the water being shallow, having only a depth of a few inches in summer, there was no need of coffer-dams.

The bridge over the River Isle Verte rests upon a rock foundation;

the water, during the dry season, being so shallow as to occasion no difficulty in founding the piers.

The piers of the Isle Verte bridge are on the skew, while the abutments are square; thus, each span has a short and a long side, the longer being 100 feet and the shorter 88 feet.

All that is worthy of remark concerning the bridges of this Division, is, that they are of wood, and constitute two of the three wooden bridges erected upon the whole line. They were commenced anterior to the reversal of the Government policy in this respect, all the other bridges being of iron.

Both bridges are built upon what is known as the Howe truss principle.

In these bridges the roadway runs on the top of the girders.

There are few curves; the two longest tangents are each about six miles.

The grades are easy.

There was abundance of ballast on the Division, but the pits were of little depth.

The work of construction was executed by Messrs. George and James Worthington. The contract was entered into in March, 1869. The time for completion assigned was 1st July, 1871, but the work was not entirely finished until 1st July, 1872. In addition to the amount of the contract, $189,700, a further sum of $35,000, for extra works, was paid.

The total length of the Division is 20 miles.

The average excavation was 18,200 cubic yards per mile, and of masonry 295 cubic yards.

The Resident Engineer in charge was Mr. Leonard G. Bell, previously employed on the Surveys of 1868–69.

PLATE NO. 5 A

Photo-Lith. by the Burland-Desbarats Lith. Co.

GREAT CLAY CUTTING AT TROIS-PISTOLES.
(During the Spring Thaw.)

See page 166.

DIVISION B.

CONTRACT No. 2.

This Division, for half its length, lies on land similar to the country crossed by the Line on Division A. After passing the village of Trois Pistoles, it enters the valley of St. Simon, a wide flat expanse bounded on both sides by high ridges of barren rock. Generally the works are light, but there are large culverts at the village of Trois Pistoles and an expensive bridge over the river of that name, besides heavy cuttings and embankments at the approaches. The cutting on the west side of the river was especially heavy, being at one place 56 feet deep. All the cuttings in this neighbourhood consisted of a blue clay of great tenacity, sometimes containing a small portion of fine dead sand. The ordinary pick and shovel were wholly inadequate in these excavations, spades proving more successful; yet, even with them, the work was tedious. The clay was dug out in small square blocks, and slung by means of single pronged iron forks, or spikes, into the wagons. It was so tenacious, that the slinging and the subsequent dumping scarcely altered the shape of the blocks. When acted upon by water and frost it would, however, slide away in a semi-fluid condition, carrying everything with it. On the west side, the cutting is on a side-hill, the foot of which rests on the shore of the St. Lawrence, while the top reaches to the flat ground about 200 feet above the river, and having about 8 feet of gravel lying on the surface. At the commencement of operations, the flow of water from between the gravel and clay, produced masses of mud which constantly slid down to the bottom of the cutting, seriously retarding the work. Such slips were to some extent obviated by a deep drain, some distance back, sunk through the bed of gravel into the underlying clay, thus tapping the superficial springs. Other difficulties, however, presented themselves. At the west end of this cutting, and under a low embankment, a small culvert had been built on apparently sufficient foundation on the side-hill. The culvert

sank somewhat, and then remained many months without any perceptible change. It, however, eventually sank so much that it became necessary to remove it altogether and build it on another site. In a few weeks after its reconstruction a landslip occurred, carrying the culvert together with the embankment and many thousands of yards of earth, to a distance of several hundred feet, into the river, leaving a gulf about 200 feet wide. This landslip was doubtless caused by the undue presence of water in the ground; and showed the necessity of deep under-drainage. The cuttings in which these difficulties were experienced, extended over a mile on the west side and a mile on the east side of Trois Pistoles. The west side was the most troublesome. Vertical shafts, fifty feet apart, and to depths varying from 25 to 30 feet under formation, were sunk along the uphill side of the railway, and about 15 feet distant from it. From shaft to shaft, tunnels about five feet diameter, were driven, each with an inclination to points where lateral off-take tunnels to the side-hill were provided for the discharge of the water collected. In the bottom of the tunnels a sewer pipe was placed and the tunnels and vertical shafts were filled with gravel. These tunnels have been effective in drying and solidifying the ground, more especially that portion immediately under the Railway. During last summer, a considerable quantity of fluid mud slipped from the surface of the South slope of the deep cut immediately to the westward of the Trois Pistoles River; but though it displaced the rails for a short distance, the road bed and underlying earth were wholly unmoved.

When the contract was entered into, the Engineer designed that the slopes of the cuttings should be made 2 to 1; and the width at formation level 30 feet. During the progress of the work these designs were over-ruled by the Commissioners, who allowed the contractors to make the slope at 1½ to 1, the same as for ordinary earth. The action of the weather, however, in continuously causing surface slips, has already brought the slope to 2 to 1, or even to a flatter slope. The cutting on the east side of Trois

PLATE NO. 5.

Photo-Lith. by the Burland-Desbarats Lith. Co.

TROIS PISTOLES BRIDGE.

Pistoles River was not attended with so much difficulty, not being on a side-hill, and not having any top bed of gravel draining into the cutting. Underdrains of an ordinary character, laid on both sides of the road-bed at a depth of 4 feet below formation level, were here sufficient. They keep the road-bed in good order; but the sides, from not having sufficient slope, are constantly slipping. The embankments also gave trouble owing to the slippery nature of the material when wet: but they now seem to have consolidated. In some parts, the slopes have been covered with gravel with good effect. The western embankment, in particular, caused anxiety for a time, a portion of it being in the old channel of the river. At this place the filling as it progressed sank continually, pushing laterally and upheaving the soft material at the base of the embankment. The application of cribwork for protecting the embankment from the wash of the river, was found beneficial. A timber crib, filled with stones, sheeted on the outside, was built round the projected base of the embankment; and although the upheaval within this crib was such as to raise the material 20 feet above the level, it was retained in position by the protecting work: the latter remaining uninjured except in one unimportant part.

The total width of the Trois Pistoles River, at the point of crossing, is about 1000 feet: the bridge of 5 spans of 100 feet each, occupies the eastern half of the channel. The piers and abutments are on rock found at a little depth. Expensive coffer-dams were not necessary, the site being nearly dry at low water. The abutments are square towers built according to Fig. 28. The piers were commenced for a superstructure of wood, but when the design was changed for one of iron, less breadth sufficed; and, accordingly, the piers were reduced in size, so that one portion of the pier appears forming the base of the superincumbent portion as a plinth. The iron work was constructed and erected by the "Fairbairn Engineering Company of England," who undertook the contract of all spans from 24 to 100 feet. An illustration of this bridge is given in plate No. 5.

East of the village there are two 15 feet arched culverts, built in

accordance with the general designs described in a former chapter. They are in embankments of 30 feet and 44 feet deep.

The line has comparatively few curves, and the tangents are correspondingly long. The grades are easy. Those reaching the maximum of 52 feet per mile, are not of any extent.

The contractors were Messrs. George and James Worthington. The amount of their contract was $299,000. They were, however, paid about $60,000 more than this sum, partly on account of the difficulty met in the cuttings at Trois Pistoles, and partly on account of extra work. The contract was entered into in March, 1859, and the work was to be completed on 1st July, 1871; but owing to the difficulties experienced at Trois Pistoles, it was not finished until the summer of 1873.

The length of the Division is 20 miles. The average quantity of excavation is 42,800 cubic yards per mile, and of masonry 603 cubic yards. The resident engineer, during the first two years, was Mr. W. H. Napier, who had been engaged in the location surveys of 1868–69. On his resignation he was succeeded by Mr. John R. Macdonnell. Mr. Bell was subsequently placed in charge till April, 1872, when Mr. H. Langton was appointed.

DIVISION C.

CONTRACT NO. 5

This Division runs for a few miles through the valley named in the last Division. Crossing a low ridge, it thence traverses a second valley until it meets the face of the mountain at the head of Bic Bay. Skirting the face of this mountain, and crossing several spurs of headlands forming the eastern side of the Harbour of Bic, it emerges on the sea shore, which it follows for several miles, keeping on a narrow belt of flat ground.

PLATE NO. 6.

Photo-Lith. by the Burland-Desbarats Lith. Co.

BRIDGE AT BIC.

The Division has heavy work of all kinds, the principal being the rock cuttings near the village of Bic. The Line has been located along the precipitous face of the mountain, in one place in front of a perpendicular cliff, part of which had to be removed to make room for the road-bed. No part of the work was attended with any peculiar difficulty. As far as Bic village the Line is somewhat curved, but the curves are for the most part of no great length, and the general direction of the Line is straight. The heavy work may be said to end at Otty Bay, where the Line, which left the shore of the St. Lawrence at Trois Pistoles, again touches it and so continues to Rimouski. In a few places between Otty Bay and Rimouski, the works come within the wash of high tides where protection was called for.

There are three bridges; one, near St. Fabien, of 80 feet span; one at Bic, of 110 feet span; and one over the Rimouski River, with five spans, each 80 feet wide. In all cases the superstructure is of iron. At the St. Fabien bridge the river has an S curve and a diversion of the stream was made, over which the bridge was built upon ground then dry. A mill stands near this place, the dam of which was interfered with by the works; and the bridge has been so constructed as to admit the passage of water to the mill, the building of a new dam and a roadway to the mill.

The bridge at Bic is built over a rocky gorge with its two abutments on the rock, as shown on plate No. 6.

The bridge at Rimouski is built at the mouth of the river. It has all the piers and abutments on rock several feet below water level. The excavation for the foundation was through gravel, in depth from 5 to 10 feet. Coffer-dams were required, but the bed of the river was so porous that great difficulty was experienced in laying dry the foundation of the deepest pier. Concrete was resorted to in this case, upon a bed of which the masonry was commenced. Plate No. 7 is a view of this structure.

There are numerous curves; the three sharpest are of 1910 feet radius, and have an aggregate length of about 1440 yards. The grades

are generally easy, although several of 1 per 100 are used. There is no elevation of importance to be surmounted.

The contract in the first instance was let to Mr. Edward Haycock for $361,574 ; at the end of one season Mr. Haycock threw up the contract. The remainder of the work was let the following spring, at $533,000 to Alexander McDonnell & Co., after $48,762 had been paid to Mr. Haycock. The work was to have been completed by 1st July, 1871, but it was not finished until 1st January, 1873. The length of the division is 26 miles. The average excavation is 35,000 cubic yards per mile and of masonry 320 cubic yards.

The Resident Engineer until the summer of 1871 was Mr. Roderick McLennan, who had been employed on the surveys of 1868–69 ; but he retired from the work and was succeeded by Mr. John R. Macdonnell.

DIVISION D.

CONTRACT NO. 8.

This Division is on comparatively level ground, some miles away from the sea-shore. The elevated range bounding the Railway on the right from River du Loup trends away to the south after passing Rimouski where this Division begins ; but the flat country rises towards the south ; and the Railway, leaving the sea, gradually inclines toward it.

The works are lighter than on any other section of the whole Railway.

There is no bridge on this Division, but there are several culverts, very few of which required much masonry. There was no especial difficulty in executing any of the works, except an arched culvert over a stream about three miles from the eastern end of the Division. This is a twelve feet culvert in an embankment about 20 feet deep. The embankment from the westward had been carried close to the site chosen

PLATE NO. 7.

Photo-Lith. by the Burland-Desbarats Lith. Co.

RIMOUSKI BRIDGE.

for the culvert, near the channel of the stream, during the first season's work. No change appeared to have taken place at the site during the winter; but on the opening of the following season, when the excavation for the culvert was commenced, the pressure of the embankment caused an upheaval of soft mud in large quantities, and in such a manner, that farther excavation was impossible. The ground was tested by boring, when a firm stratum was discovered some 18 feet below the surface. It was then determined to construct a pile foundation. The piles were easily driven, but so soft was the material penetrated that the driving of a fresh pile would partially float those driven. Consequently, they had to be weighted until the masonry was started. The outer piles were driven perfectly close, and formed a kind of coffer-dam, the opposite sides of which were tied together to prevent spreading and in order effectively to enclose the whole space underneath the structure. A bed of concrete was placed over the piles, and on this foundation the masonry was commenced. This work was somewhat troublesome, a whole season having been spent upon it. But it was finally completed at no great cost, and has answered the purpose satisfactorily.

The line is generally straight, and nearly parallel to the direction of the St. Lawrence.

The contractor was Mr. Duncan McDonald, whose price was $100,000. The contract was dated 1st November, 1869, the work to be finished on the 1st July, 1871. It was completed in the December of that year.

The length of the Division is 20½ miles. The average quantity of excavation is about 15,000 cubic yards per mile, and of masonry 180 cubic yards.

The Resident Engineer was Mr. John Lindsay, previously employed on the Surveys of 1868–69.

DIVISION E.

CONTRACT No. 13.

The Railway, on this Division, crosses the water-shed between the St. Lawrence and Restigouche Rivers,and passes over an intricate, hilly country, with deep valleys, intersected and crossed by a constant succession of ridges, whose summits rise to a considerable elevation between the different tributaries of the Rivers Tortigaux and Metis. It was accordingly a matter of some difficulty to find a good location through it. The country was thoroughly explored and the best route obtained. The line, nevertheless, has numerous curves, many of them of short radius. Where the line crosses the long ridge overlooking the St. Lawrence, it sweeps round a full semi-circle, part of which is in a long deep cutting. On the entire Division there is an aggregate length of more than eleven miles of curves, and the aggregation of curvature is about 1407 degrees.

One continuous grade, rising up to cross the ridge overlooking the St. Lawrence, is 2¾ miles long, and rises at the rate of 58 feet per mile. This is followed by another grade, ascending in the same direction at the rate of 52.80 to the mile, for a length of over 2½ miles. There is an aggregate length of over 10½ miles of grades rising 1 in 100; and of grades rising 0.8 or 0.9 in 100, a farther length of 1½ miles; so that of steep grades there is an aggregate length of 15 miles, out of a total length of 20½ miles, the extent of the Division.

The work on this Division is the most expensive, with one exception, on the whole Railway. The excavation and embankment far exceeded the quantity in any other locality. A large proportion of the excavation was in rock, and one embankment is 80 feet deep.

The quantity of embankment required was much in excess of the quantity of cutting on the line, and, therefore, extensive borrowing pits were necessary. In some spots, the material available for borrowing was so scanty that many acres of ground were stripped to furnish the

PLATE NO. 8.

Photo-Lith. by the Burland-Desbarats Lith. Co.

GRAND METIS BRIDGE.

quantity required. The total quantity excavated was about 1,750,000 cubic yards, of which one-sixth was rock.

There are seven tunnels, varying from 6 feet to 12 feet in diameter, for carrying streams across the Railway; and one tunnel, 20 feet diameter, parallel to the Railway, through a tongue of land round which the River Tortigaux flowed, crossing the Railway line twice. This tunnel takes the whole stream and saves two bridges across the line. It is about 500 feet long. All the tunnels are cut through rock; and, with one exception, it has not been found necessary to line any of them with masonry.

One of the clay cuttings gave some trouble, which would have been avoided by making it wider and with flatter slopes, in the first instance.

An embankment across soft, swampy ground, was laid upon a platform of trees placed side by side. The material sank *en masse,* raising the surface beyond the embankment to a height of from six to eight feet above the original level, and to the extent of 20 feet out from the slope of the embankment. The embankment is now perfectly firm.

The Metis bridge is alone of importance on the Division, having four spans of 100 feet in width. Some difficulty arose with the foundations. The western abutment was built upon a double platform, with concrete deposited between the timbers. The eastern and western piers were built upon a pile foundation; the centre pier was built upon a stratum of gravel and boulders, the foundations being taken well down. The coffer-dam was afterwards filled with the best concrete, made of Portland cement.

In order to turn the river, and prevent its flowing between the Eastern pier and the East bank of the river, a rough wing wall was built. The piers are protected from the wash of the river by rip-rap laid round them. The total height of the bridge, from the bed of the river to the formation level, is 60 feet. Plate No. 8 shows the bridge completed.

The Contractors were Messrs. W. E. MacDonald & Co., who carried

on the work almost to completion. The contract was entered into in May 1870, the work was to have been finished on the 1st July, 1872, at a cost of $934,933. But, about the end of the year 1873, when the completing of the work still required an expenditure of $126,500, it was taken off the Contractors' hands and finished by the Government late in the year 1874. The length of the Division is 20½ miles.

The average quantity of excavation is almost 85,000 cubic yards per mile, and of masonry 423 cubic yards. The total length of the tunnels for the passage of streams is 1,593 feet.

The first Resident Engineer, in charge of the Division, was Mr. W. F. Biggar, previously employed on its exploration and location. On his retirement he was succeeded by Mr. H. J. Cambie, who remained in charge until the works were taken out of the hands of the Contractors, after which, Mr. William McCarthy was placed in charge.

DIVISION F.

Contract No. 14.

At the end of the first mile the railway passes over the highest summit on the whole line. It then descends through an easy country to the basin of the Metapedia Lake and continues to run on a flat, wide, tract of land, bordering the lake, to its outlet.

The summit which is 743 feet above the sea, is at Lake Malfait, the source of the River Sayabec, flowing eastward into Lake Metapedia. It is on the dividing ridge between the waters of the St. Lawrence and those of the Bay Chaleur. At the commencement of the Division the curves are of short radius, their aggregate length, however, is not great, being little over a mile. In the first seven miles the aggregate length of grades, ascending and descending, is nearly five miles, of 1 per 100. The remaining grades, together with the curves, are light.

There are only three bridges of any importance, namely, that over

PLATE NO. 9.

Photo-Lith. by the Burland-Desbarats Lith. Co.

AMQUI BRIDGE.

the St. Pierre, near the head of the Metapedia Lake; that over the Tobegote, near the lower end of the same Lake; and that over the Amqui, at the end of the division. The spans of these bridges are respectively 80, 30, and 100 feet. The St. Pierre bridge is built on a natural foundation of gravel and boulders. At the Tobegote bridge site, soft material exists to a great depth, necessitating a pile foundation of peculiar construction, and the use of concrete. The Amqui bridge is also built on a pile foundation, protected by rip-rap. The principal part of the stone for the Amqui bridge is compact, hard, yellow sandstone taken out of cuttings on the division. A view of this bridge is given in plate No. 9.

The contractors were Messrs. Neilson & McGaw, whose price was $245,475 and who carried on the work to completion. The work was to have been completed on 1st July, 1872, but it was not finished until the summer of 1875.

The total length of the Division is 22½ miles. The average quantity of excavation is about 21,000 cubic yards per mile and of masonry 203 cubic yards.

The first Resident Engineer in charge of the works was Mr. Henry Carre, who had been on the surveys of 1868–69. He remained in charge for about 1½ years, when he retired and was succeeded by Mr. John Lindsay, who was again succeeded by Mr. T. D. Taylor.

CHAPTER IX

THE RESTIGOUCHE DISTRICT.

General Description—Metapedia Valley—Restigouche Valley—Bay Chaleur—Geological features—Division G, Contract No. 17—Division H, Contract No. 18—Division I, Contract No. 19—The Restigouche Bridge—Artificial foundation—Climatic forces—Ice jams—Shoves—Freshets—The massive character of the Piers—Division R, Contract No. 3—Division L, Contract No. 6—Division M, Contract No. 6—Division M, Contract No. 9—Division N, Contract No. 15—The Tête-a-Gauche Bridge—The Nipissiquit Bridge.

This District includes the lower half of the Metapedia valley, crosses the Restigouche at the mouth of the Metapedia, and continues by the Bay Chaleurs. Its length is 128 miles. It embraces the following divisions

Division	G—Contract No.	17	....	20	Miles long
"	H "	18	....	20	" "
"	I "	19	....	10	" "
"	K "	3	....	24	" "
"	L "	6	....	21	" "
"	M "	9	....	21	" "
"	N "	15	....	12	" "
	Total		....	128	" "

The Line for 40 miles follows a south-easterly direction, and then runs easterly for 30 miles, after which, its course is south-east, finally bearing nearly due south.

The Metapedia valley is generally contracted, with steep hills and rocky sides rising to the height of 600 to 800 feet, for many miles, barely affording space for the Railway, the river, and the Metapedia Road. The adjoining country, in many places deeply furrowed by streams, rises, approximately, 800 feet above the valley.

PLATE NO. 10.

Photo-Lith. by the Burland-Desbarats Lith. Co.

RIVER MATAPEDIA.

(Railway on opposite Bank.)

There are several lateral valleys, the principal of which are those of two rapid tributaries of the Metapedia, the Rivers Causapscal and Assametquagan, rising in the Shikshok Mountains to the east of the Railway, and those of McKinnon's Brook and other streams, on the western side. For a distance of 20 miles below the mouth of the Metapedia, the Railway follows the valley of the Restigouche, between high, steep, rocky hills. It then crosses the promontory, at the point of which lies the Harbour of Dalhousie. The Line runs about a mile from the Bay Chaleur, sometimes touching the shore, until it reaches the village of Bathurst. It then leaves the shore, in order to cross the promontory between Bathurst and Miramichi. The country is slightly rolling, and comprises clayey, gravelly, peaty and rocky soils. The high mountainous country is found more inland, the intervening distance being broken and hilly.

The rocks in the Restigouche district, with some trifling exceptions, belong to the Gaspé limestone series of upper Silurian age. This series is known to occupy an immense area. Nearly the whole hydrographic basin of the Restigouche belongs to this series. The rocks consist of grey and dark shales and limestone. On the Metapedia, vast deposits of calcareous shaly and slaty strata appear interstratified with limestone bands. Near the "Devil's Elbow," sandstone is met of a greenish gray color. At the mouth of the River Restigouche, a small basin of the lower carboniferous rocks occurs. It consists of red sandstone and conglomerates. Conspicuous conical hills of amygdaloid and other trap rocks attract attention near Dalhousie. The basin is flanked on both sides by the Gaspé limestone series, which generally occupies the elevated country overlooking the valley, and it extends from Dalhousie to Bathurst. It afforded excellent limestone for the masonry at several places.

Grey granite is exposed on the rivers flowing into Bathurst Harbour, composed of opaque white feldspar, colourless translucent quartz, and black mica. In some respects it resembles the celebrated Aberdeen granite; and yielded massive building material for some of the finest masonry on the Line.

The principal rivers are the Metapedia, the Restigouche, Eel River, the Charlo, Jacquet River, the Tête-à-gauche, and the Nipissiguit.

The Metapedia drains an area of 1700 square miles; the Restigouche, with its tributaries above the crossing of the Railway, drains about 5200 square miles, of which the Upsalquitch, a branch from the south, drains 1400. The rivers from the Restigouche down to the Nipissiguit drain about 1300 square miles, and the Nipissiguit in a course of 70 miles drains 800 square miles.

Mr. Marcus Smith conducted the surveys of the District in 1868–69, and afterwards had charge of the works of construction until April, 1872. He was succeeded by Mr. L. G. Bell.

DIVISION G.

CONTRACT No. 17.

This Division lies in the valley of the Metapedia river. The western half traverses a comparatively open country with gently sloping hills. The eastern half is contracted between steep, rocky banks. About one half of the Line is curved, but the curves, except in a few cases, are of ample radius. The grades, which are easy, have generally a descent eastwards. The greatest difference of level, that between the two ends, is 212 feet. The works are moderately heavy, requiring care in their execution, but no very great difficulty was experienced. The total quantity of cutting is about two-thirds of a million cubic yards, of which one-fifteenth is rock. But little of the rock excavated was found suitable for masonry. The ashlar stone had to be brought some distance, chiefly from the eastern end of Lake Metapedia, but material for the smaller structures was obtained near the middle of the Division at Otter Brook quarry. This stone is a kind of sand-stone, close and firm in the texture, and generally well stratified.

Two bridges cross the Metapedia, the first at Causapscal, near the

PLATE NO. II.

Photo-Lith. by the Burland-Desbarats Lith. Co.

CAUSAPSCAL BRIDGE.
(1st. Crossing of River Matapedia.)

middle of the Division, the second nearer the eastern end. At each crossing the line passes the river at an angle of 45°, and the bridges, consequently, are askew. Each bridge has three spans of 100 feet wide on the skew face. No difficulty was experienced in their construction. The foundations were built in caissons excavated from within, pumps of some power being requisite to control the water. At one point, the Line passes through a sharp bend in the river, called "Aleck's Elbow," owing to a very high cliff which causes it to sweep round a sharp curve of a quarter of a circle. A diversion of the river was made, the Railway being protected by crib-wharfing. There are several pieces of crib-wharfing in the Division, but the work at "Aleck's Elbow" is the heaviest and most important. Fig. No. 32

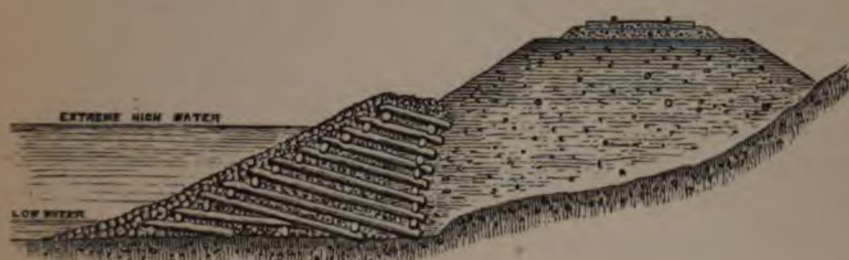


Fig. 32.

illustrates the manner in which crib-wharfing was constructed when the line encroached on the river. The embankment was faced with rip-rap, interlaced with a rough framework of cedar timbers, as a precaution to prevent inroads by flood-water on the newly formed earthwork.

Abundance of ballast was found on the Division. The contractor was Mr. S. P. Tuck, the price being $440,000. The work was to be completed on the 1st July, 1872. In 1874, there being still much of the work to be performed, the Government took the Division out of the contractor's hands and finished it by day's labor. It was completed in 1875.

The Division is 20 miles long.

The average quantity of excavation is about 30,000 cubic yards per mile, and of masonry 435 cubic yards.

The resident Engineer was Mr. Walter George Bellairs. Mr. Bellairs dying in April, 1874, was succeeded by Mr. John R. Macdonell.

DIVISION H.

Contract No. 18.

This Division lies in the valley of the Metapedia, but in a more contracted portion than the Division last described; the line being confined within the narrow limits of the high, abrupt boundaries, and generally following the windings of the river. The curves are numerous, and many are of short radius, but very few exceed 1,000 feet in length.

There are several heavy cuttings and embankments, but neither cuttings nor embankments were attended with difficulty.

Many of the rock cuttings turned out excellent stone for masonry backing, and for covering culverts; but little of it, however, could be used in face work. A portion of the building stone used came from the Otter Brook quarry. As the slopes of the embankments, in some cases, extended to the bed of the river, crib-wharfing, similar to that constructed at "Aleck's Elbow," was adopted where expedient. In other places, near the large rock cuttings, large seized flat stones were built into a heavy wall with a face batter of 1¼ to 1, backed up with ordinary stones as in Figure No. 33.

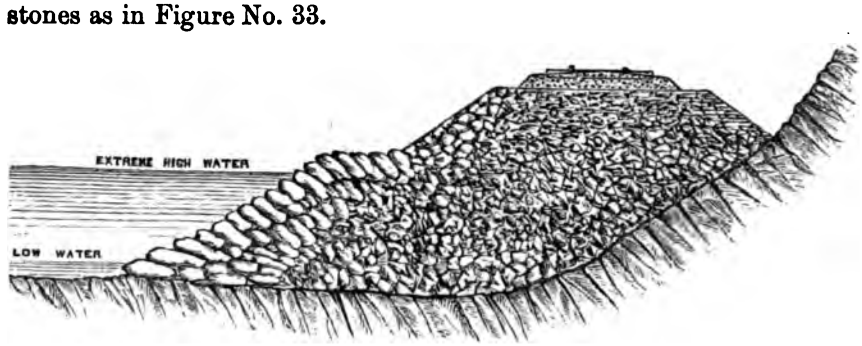


Fig 33.

PLATE NO. 12.

Photo-Lith. by the Burland-Desbarats Lith. Co.

RIVER MATAPEDIA.

Mill Stream Bridge in progress in the distance.

There are but two bridges of any importance on the Division, namely, that over McKinnon's brook, having two spans eighty feet wide, and that over the third crossing of the Metapedia at Millstream, having four spans, each 100 feet wide on the skew face. Like the upper Metapedia bridges, the latter crosses the river at an angle of 45° with the general direction of the stream. Notwithstanding that the whole bed of the river, for a considerable distance up stream, is rock, the foundations of the bridge did not reach it, owing to the dip of the strata being too great. Attempts were made but it was found impracticable to sink the foundation down to it. They are accordingly on the coarse gravel which forms the bed of the river. Piling was not considered necessary. The eastern abutment and the three piers were built in water, from 6 to 8 feet deep, all the masonry being carried 14 feet under low water and protected by rip-rap. A good quarry was discovered near the bridge; not, however, until a quantity of stone had been brought down from the quarry at Metapedia Lake The cost of transportation was necessarily great; but the Contractor requiring cedars for crib-wharfing, which he procured at the Lake, they were used for rafting the stone. Each raft was worked by three Indians, and carried about two cubic yards of stone. The distance from the quarry on the Lake to the bridge is nearly 50 miles. Plates Nos. 12 and 13 are illustrative of the site and character of the structure.

There are several cast iron pipe culverts, 3 feet in diameter, on the steep side-hill, for which they are peculiarly suitable, and prove highly satisfactory.

The work on this Division was undertaken early in the summer of 1870, to be finished by 1st July, 1872. It was not, however, until the beginning of 1876 that the work was finally completed.

The Contractors were Robert H. McGreevy & Co., the contract price $648,600. At the beginning of the season of 1875, the Government took the work into their own hands.

The length of the Division is 20 miles. The average quantity of excavation is about 45,000 cubic yards per mile, and of masonry 445

cubic yards. There is a total length of 424 feet of cast iron pipe culverts. The first Resident Engineer was Mr. W. G. Thompson. In April, 1872, he was succeeded by Mr. Peter Grant.

DIVISION I.

CONTRACT No. 19.

About two-thirds of this Division is located in the Valley of the Metapedia, At the mouth of this valley the Railway crosses the Restigouche, by the bank of which the line is continued. It has many curves, few of them, however, extend for much length. Heavy cuttings and embankments are not frequent, owing to narrow stretches of flat ground along the river bank which afford space for the line. At the crossing of the Restigouche there are two heavy rock cuttings and one long and somewhat high embankment. The rock cuttings supplied a great quantity of the stone required to raise the base of the embankment above high water mark; one cutting furnished all the stone used in the Restigouche bridge, except material for the face of cutwaters, copings of piers, and girder seats, which are of Bathurst granite.

There are several pieces of heavy protection work, but none attended with any special difficulty. A large quantity of crib-wharfing had been provided for in the estimates. Owing, however, to a method of removing earth, then, at little cost, successfully introduced by the Contractor, the crib-work was not considered necessary. At this place, a steep bank about 120 feet high and composed chiefly of gravel projected for a distance of about 1000 feet along the edge of the river, leaving no site for the Railway. It was designed to construct an embankment along the river side protected by extensive crib-wharfing. The sub-contractor introduced a method of washing away the gravel by means of water jets. Streams from the high side-hills were dammed

PLATE NO. 13

PIER.—MILL STREAM BRIDGE.
3rd Crossing River Matapedia (in winter.)

up at a point about half a mile from the work; the water was conveyed by a wooden trough to the place where required, and directed against the face of the bank in a continuous stream. Its force undermined and loosened the material so effectually that masses, often by thousands of yards, would slide into the river in a brief space of time. Immense quantities of material were thus removed, with very little manual labour and at a cost, probably, less than one-sixth of ordinary excavation. The result was that the railway was made on solid ground, requiring little or no protection. The change had also the effect of flattening the curvature of the line. This system of excavating material by an available flow of water was so successful, that it was adopted on other portions of the line where streams with sufficient fall could be obtained.

There are several small girder bridges on this division, but the chief structure is the Restigouche bridge, a work which calls for special notice.

The Division was originally let to Mr. S. P. Tuck, to be completed 1st July, 1872. It was afterwards transferred to Messrs. Thomas Boggs & Co. Subsequently an arrangement was made, by which, the Bridge was severed from the other work, Mr. Martin Murphy becoming contractor for the main structure.

THE RESTIGOUCHE BRIDGE.

The River Restigouche, constitutes the boundary between Quebec and New Brunswick. The Railway bridge connecting the two Provinces is the only bridge which crosses the River. It is situated below its confluence with the Metapedia. After emerging from the contracted valley through which the Metapedia flows, the railway turns almost at right angles, to follow the Restigouche. The main stream for some distance is hemmed in between high steep hills, rising abruptly to a height of from 500 to 700 feet, and the sudden change in the direction of the Railway, necessitates the construction of the bridge on a skew of forty-five degrees.

The hills are composed of a metamorphosed slate, much contorted and so tilted, that the direction of the cleavage is not easy to determine. The river takes the direction of the strike and has, no doubt, shaped its course from denudation. Blue clay underlies the gravel in the bed of the river, but it is undoubtedly local.

Soundings and borings were made through the ice, early in 1869, which led to the opinion that the bed of the river was rock overlaid with some inches of gravel. But it was found that stones imbedded in gravel, were the hard substance met, and that the solid rock was at a much greater depth. The outcrop of rock on both sides of the valley suggested that the stone in the gravel was rock, *in situ*. Subsequent borings, however, showed the gravel to extend from seven to ten feet, underlying which, plastic blue clay is found. The Section, plate No. 17 will show the position and thickness of the different strata.*

At pier No. 1, rock was reached at 53 feet under the summer level of the river; at pier No. 2, at 75 feet; at pier No. 3 at 62 feet; and at pier No. 4, at 54 feet.

Accordingly, piling was necessary in all the foundations, except for that of the Easterly abutment, which was built on the rock. The work of piling was continued throughout the winter, that season being suitable for this operation, the ice forming a platform for the machinery. The coffer-dams were protected by triangular shaped cribs to act as breakwaters, so constructed as to prevent injury to the works,

* The more recent borings show the following strata at the different structures.

	West abutment.	Pier No. 1.	Pier No. 2.	Pier No. 3.	Pier No. 4.	East abutment
	ft.	ft.	ft.	ft.	ft.	ft.
Loam above summer water.	10					
Depth of ordinary water		5	3	7	10	6
Gravel	10	7	10	7	4	
Blue clay	60	38	60	48	40	
Black clay and sand	6	3	2			
Total Depth from ordinary low water to rock	No rock met.	53	75	62	54	6

Photo-Lith. by the Burland-Desbarats Lith. Co.

from the ice. The arrangement of the piers, coffer-dams, and break-waters is shown on plate No. 17.

The pumping was effected by five engines, with an aggregate of 70 horse power. Centrifugal pumps, capable of discharging nearly 6000 gallons per minute were used. Owing to the stratum of gravel, and the heavy flow of water, the excavation was performed with difficulty. The pier foundations consist each of close square piling, enclosing an area of 102 feet by 16 feet, with four rows of intermediate piles, three feet apart. The space between the piles was filled with concrete and a platform was constructed upon them 8½ feet under water, so as equally to distribute the weight of the superincumbent masonry. Much difficulty was experienced in the execution of these works in a deep and rapid river. The pile driving, of more than 60,000 lineal feet of timber was carried on almost continuously from August 1872 until April 1874. Ice begins to form in this River in November; and although the rapids of the River remain for some time open, where the current is slight, ice sufficently firm to carry a man will form in twenty four hours. From November until March, but little rain falls, the thermometer ranging from 32 above to 32 below zero. The average, during the five years occupied in constructing the bridge is slightly below zero. A change in the weather, when the winter sets in unusually early, accompanied with rain, will occasionally raise the water and break up the ice, producing "ice-jams." The Metapedia is especially liable to these incidents; in the Restigouche they are not common. The low temperature as a rule, from November to March, produces ice from two to four feet thick and about the end of March it reaches its maximum strength. Moreover, the ice is not confined to the surface of the River. As in many northern localities anchor ice is developed to a great extent, sometimes to double the thickness of the surface ice. It is not therefore surprising that at the end of winter a sudden thaw raising the water of the main stream and setting adrift the whole winter ice, should produce astonishing results. Floating down stream, these masses of ice meeting with obstructions will pile one on the other, until a "jam," completely

PLATE NO. 15.

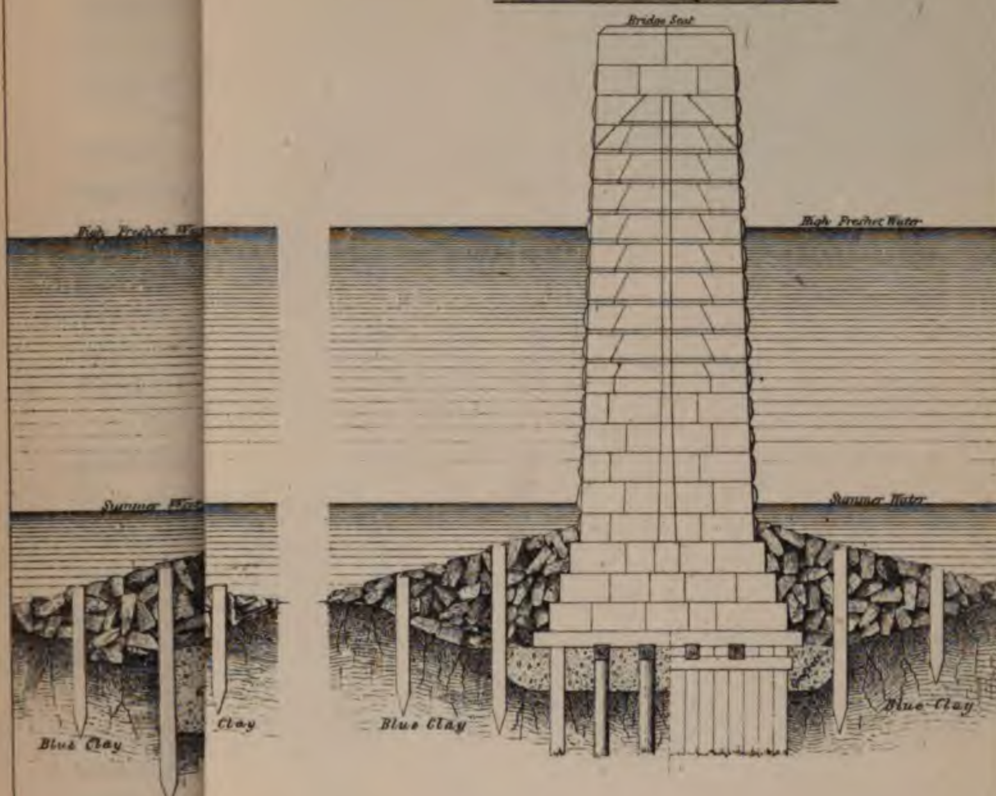
Photo-Lith. by the Burland-Desbarats Lith. Co.

PIER.—RESTIGOUCHE BRIDGE.
(Winter view.)


BUTME

PLATE No. 18.

END ELEVATION.



TERCOLONIAL RAILWAY.

RESTIGOUCHE BRIDGE:

DRAWINGS OF FOUNDATION AND MASONRY OF PIERS,

Sandford Fleming, *Engr-in-Chief*.

SCALE:

Photo-Lith. by the Burland-Desbarats Lith. Co.

owing to the current, the ice impinges with great force on that side of the river, the foundation being well let into the rock, and the wall being well built and protected, no injury is likely to result.

The masonry, generally, is built of stone found in the adjoining railway cutting, on the south-easterly bank, where blocks of good dimensions were obtained. The work is executed in courses, 30 inches thick in the footings, and 24 inches in the body of the work, the blocks being from six to eight feet long. The stone is tough and well adapted for work requiring great strength. Being difficult to dress, however, except in the line of cleavage, it was decided to use granite for the cutwaters and quoins.

The granite was brought from the River Nipissiguit, beyond Bathurst. It is not unlike the well known Aberdeen granite, the scales of mica only being somewhat smaller. The distance from the quarry is nearly 90 miles, 70 of which only were by open navigation. The blocks were therefore prepared in the quarry, and when reduced to their proper size, weighed from three to nine tons each. The massive character of the piers is shown by plate No. 15.

The necessity for great strength is evident from the foregoing account of the phenomena yearly witnessed in the river, which no light structure could resist. The face stones of the cutwaters, the coping, bridge seats, and the two upper courses of ashlar, together with the skew quoins on the down-stream end of piers, are of granite. A striking contrast is accordingly obtained to the dark slate colour of the body of the masonry, which adds to the appearance of the structure.

Plate No. 16 is a view of the bridge from the south bank of the river.

The total quantity of masonry exceeds 6000 cubic yards; the whole is built in Portland cement, and the exposed parts of piers were secured by strong iron clamps, so contrived that it would be impossible for floating logs, or ice, to disturb a single stone without moving the whole mass to which it is attached.

The work was commenced in the summer of 1870, and completed

by Christmas, 1875. During the whole of that time, notwithstanding the heavy plant and material employed, not a single serious casualty occurred. Mr. Martin Murphy was the contractor. Mr. Peter Grant was in charge of the work throughout, as Resident Engineer.

DIVISION K.

Contract No. 3.

This Division is for several miles of its length on the slope, or at the base, of steep and rocky side-hill.

No especial difficulty attended any of the cuttings, or embankments, except the cutting at Morrissey's Rock, a point of rock jutting out sharply into the River Restigouche, and which it was necessary to pierce in order to avoid curvature and heavy protecting works. The maximum depth was 95 feet, the length of the point was 600 feet, half of which was about 20 feet deep. As material was required for embankment, it was designed to make an open cut throughout, but 166 feet of the length is tunnelled. The rock lies in shapeless unstratified masses, and no difficulty was experienced in completing the work. The rock is hard, but exposure to the weather may render it friable, in which event, it may become necessary to line the tunnel with masonry. This is the only tunnel through which the railway passes.

At Morrissey's Rock there is a diversion of the public road for a length of 2½ miles.

There are on this Division four bridges; one with a single span of 40 feet wide; one at Christopher's brook, near the "head of the tide" in the Restigouche, has eight spans, each of 60 feet: the two other bridges, one at Campbellton, and one over Eel River, have each three spans 60 feet wide. The bridge at Christopher's brook provides for the passage of the stream, the conduit to a saw-mill, the tail-race from a grist-mill, and access from the public road to a lumber yard. The masonry is built of hard, red stone found near the spot. The Campbellton bridge is built in tideway over the mouth of a small river.

PLATE NO. 19

Photo-Lith. by the Burland-Desbarats Lith. Co.

TUNNEL AT MORRISEY'S ROCK.

The foundation is on piles. The embankment leading up to the bridge is protected by crib-work from the wash of the sea.

On the steep side-hill, pipe culverts are introduced to a greater extent than on any other division in the District.

Much of the stone was taken from the quarry at Bordeau on the Quebec side of the Restigouche; of a bluish, grey sandstone, easily quarried and worked.

The port of Campbellton, about the middle of this Division, was of advantage during construction; and the Government made a pier and a short branch railway, by which the rails were delivered. About 10 miles eastward from Campbellton, the line leaves the shore of the Restigouche, and traverses the promontory on which Dalhousie is situated. Dalhousie, at the head of the Bay Chaleur, has a fine natural harbour. It was much to be desired that the railway should pass by this place, but though the portion of the line to the west would be of easy construction, that from Dalhousie, toward the east, would have involved heavy cuttings, sharp curves, and a tunnel, besides increasing the length about four miles.

The contract was let to Messrs. Elliott, Grant and Whitehead, in March, 1869, for the sum of $288,000. But the work could not be completed for that amount. Accordingly in May, 1870, a new contract was made with Messrs. F. X. Berlinquet & Co., for the sum of $462,444, being an addition of about 77 per cent. to what remained of the money unpaid to the original contractors under their contract. This sum, however, proved still insufficient. The contractors were bound to complete their work by 1st July, 1871, but though they had received from the Commissioners large advances, in the beginning of the working season of 1873, nearly two years after the date appointed for the completion of the work, and when there was still a great deal of work of all kinds to be done, they notified the Commissioners that, without considerable help in money, they could not continue. Their contract was then annulled, and the work was completed by the Government in 1874.

The division is 24 miles long. The average quantity of excavation is about 26,000 cubic yards per mile, and of masonry 477 cubic yards. There is also a total length of 1065 feet of cast-iron pipe culverts.

The Resident Engineer was Mr. Henry A. F. McLeod, who remained in charge until the work was practically completed.

DIVISION L.

CONTRACT NO. 6.

This Division lies along the Bay Chaleur at no great distance from it. There are several heavy cuttings and embankments, but none which caused any especial difficulty. Several embankments being close to the waters of the Bay, have been protected by rip-rap, or crib-wharfing.

The first five miles of the Division are straight, and the curves on the whole are few and easy.

The grades also are light.

There are on the whole Division nine bridges, amounting to 1150 feet in length. The largest is the Jacquet bridge, which has three spans, each 100 feet wide. It is built in the estuary of the River Jacquet, which, although 1500 feet wide at high water, has very little water at low tide, except in the main channel, about 100 feet wide. A good gravel foundation was obtained for the piers and the eastern abutment, but the foundation for the western abutment was not attained until the excavation had reached a depth of between 12 and 15 feet below the bed of the river. The main channel lies between the west abutment and the west pier, from 6 to 8 feet deep at low water. The force of the current, in the spring, against temporary obstructions, caused such an eddy that a great deal of the bed of the river near the west abutment was scooped away, almost to the level of the foundation, 12 feet or more below the level of the old bed, but no farther

PLATE NO. 20.

Photo-Lith. by the Burland-Desbarats Lith. Co.

NEW MILLS BRIDGE.

damage was done. In the following winter a large quantity of heavy stones was sunk through the ice into the bed of the river, completely covering all parts liable to be acted on by freshets, and so arresting the scour. The embankments on both sides of the Jacquet river bridge have been protected by crib-wharfing.

Of the nine bridges on this Division an illustration of one—New Mill Bridge—is furnished. Plate No. 20. The contract was let in April, 1869, to Mr. Jacques Jobin, for $241,500, the work to be finished on 1st July, 1871. This contract was annulled, and a new contract was entered into in May, 1870, with Messrs. F. X. Berlinquet & Co., to be finished by the 1st July, 1871. The price contracted for was $456,946, being considerably more than twice the amount then remaining unexpended under Mr. Jobin's contract, and nearly double the amount of the first tender, made by Messrs. Berlinquet & Co., for the whole of the same work. But the new contractors, in the beginning of 1873, were unable to proceed; their contract was annulled, and the work was completed in 1874, by the Government,

The length of the Division is 21 miles; the average quantity of excavation about 26,000 cubic yards per mile, and of masonry 572 cubic yards.

The Resident Engineer was Mr. Edward Lawson, who had been on both the exploratory survey of 1864, and the location survey of 1868. He was succeeded by Mr. Henry N. Ruttan, who remained until the whole was nearly completed and transferred to the Department of Public Works.

DIVISION M.

Contract No. 9.

This section is generally light; nevertheless there are several heavy rock cuttings, and one deep, but short embankment.

The grades are easy, there being a difference of only 113 feet between the highest and lowest levels. The Division is almost all on tangent lines, there being but five curves of a total length of something more than a mile. But as all these curves, except the last, which is only 500 feet long, and flat, turn in one direction, toward the south, the general direction of the line at the end of the division, is nearly at right angles to that at the commencement. There is one tunnel across the line, made in rock on the side of a deep valley, by which tunnel, a long culvert in the bottom of a mill-dam has been obviated. The rock in which the tunnel has been cut is not firm, so that eventually the tunnel may have to be lined.

There are three bridges, all on rock foundations, with but little excavation. That over the river Belledune, has two spans 60 feet wide, and is across a short valley 50 feet deep. The other bridges, over the Elm Tree and Nigadoo rivers, have each only one span 80 feet wide.

The Division is almost all in bush land, and generally about one mile distant from the shore of the Bay Chaleur.

The length of the Division is 21 miles. The average quantity of excavation is about 22,200 cubic yards per mile, and of masonry 339 cubic yards. The work was let in October, 1869, to Messrs. J. B. Bertrand & Co., for $354,897, and was to have been finished on 1st July, 1871. These contractors signified their inability to proceed with their work at the time when Messrs. Berlinquet & Co., with whom they were connected, failed to carry out their contract. In 1873 the Government assumed the completion of this division also.

The Resident Engineer, was Mr. Charles Odell, who had been employed on the location surveys of 1868–69.

DIVISION N.

CONTRACT NO. 15.

This Division leaves the Bay Chaleurs, but again touches it at th

PLATE NO. 21.

Photo-Lith. by the Burland-Desbarats Lith. Co.

TÊTE-À-GAUCHE BRIDGE.

head of Bathurst Harbour. In general direction it bears southwards, towards the base of the promontory which lies between the Bay Chaleur and Miramichi, terminating at Shippigan.

It is a short section, only 12 miles long, but in proportion to its length, it is one of the most expensive.

There are nine curves, amounting in the aggregate length, to nearly 2¾ miles; they are all easy. The grades also are light; the greatest difference of level between any two points, being only 78 feet. The rock cuttings are comparatively light, but there are several heavy earth cuttings and embankments. Of these, two embankments, at Tête-à-gauche, contain 120,000 cubic yards, and the cutting between them held 90,000. Another embankment at Nipissiguit river, contains 90,000 cubic yards, and the cutting at the west end of it, from which it was principally made, gave 74,000 cubic yards. Several of the cuttings east of Tête-à-gauche, had good clear gravel, from which a large quantity of ballast was obtained. In a few cuttings the clay was of a slightly sandy nature, and slipped until the sides assumed a flat slope. The excavation caused some trouble during wet weather; but the cuttings are neither long nor deep.

The heaviest work was in masonry, there being six bridges, besides three large arched culverts. One of the latter is 20 feet span, in an embankment 30 feet deep, and is built of heavy granite ashlar. Near to this is the bridge over the River Tete-à-gauche, which has five spans, each 100 feet, crossing a valley about 55 feet deep. The next important bridge, is that over the River Nipissiguit, with six spans, each 100 feet. The river is 500 feet wide and the depth of its bed, below formation level, is 43 feet. The water is not deep during the summer season, but flows in a shallow, turbulent stream, on a rough rocky bed. The masonry was laid at low water, without difficulty. Plates Nos. 21 and 22 illustrate these important structures.

The masonry on this Division is marked by the massive character of its granite courses.

The granite cutwaters and quoins of the Restigouche Bridge,

were transported from this locality. The granite was easily cut, and the quarrying of stone was not expensive, as there was little waste and no stripping.

The length of the Division is 12 miles. The average quantity of excavation is 52,000 cubic yards per mile, and of masonry 1061 cubic yards.

The work was let on the 15th June, 1870, to Messrs. J. B. Bertrand & Co. They failed in fulfilling their contract, and the work was assumed by the Government and completed in 1874.

The Resident Engineer was Mr. P. A. Peterson who had been employed on the location survey. He was succeeded by Mr. Charles Odell, who remained in charge until the work was completed.

The starting point for the proposed branch to Shippigan, has been located near the crossing of the Nipissiguit. This branch was surveyed in the winter of 1873-74, and was designed to form a short mail route between England and America. The harbour of Shippigan was also surveyed, soundings being taken through the "Shippigan Sound," and the channel out to the Bay Chaleur, over an area of about 20 square miles.

The result of the survey is to show that only wharves and piers, a short distance out from the land, are required to make the harbour available for the largest steamers; they likewise establish the fact, that the branch railway can be constructed without any extraordinary expenditure.

PLATE NO. 22.

Photo-Lith. by the Burland-Desbarats Lith. Co.

NIPISSIGUIT BRIDGE.

CHAPTER X.

THE MIRAMICHI DISTRICT.

Features of the District—Extensive Carboniferous basin—Division O, Contract No. 16—Division P, Contract No. 10—Division Q, Contract No. 20—Miramichi River Crossing—Deepwater Branch—Division R, Contract No. 21—Division S, Contract No. 22—Division T, Contract No. 23.

This District commences East of the River Nipissiguit. The line is remarkably straight, there being but a slight bend in the general direction, at the River Miramichi, calling for the introduction of some curves. The District has the greatest length of tangents; and the longest single tangents, on the whole Railway, one being continuous for a distance of thirty miles.

The following are the Divisions:

Division	O,	Contract	16,	18¾	Miles long.
"	P,	"	10,	20	"
"	Q,	"	20,	6	"
"	R,	"	21,	25	"
"	S,	"	22,	25	"
"	T,	"	23,	22½	"
Total length,				117¼	miles.

The first two divisions lie on the water-shed between the tributaries of the northwest Miramichi and those waters falling into the Bay Chaleur and the Gulf. The streams crossed are consequently small. The surface of the country is slightly undulating, and large tracts of flat boggy land and swamps are met. The land is wild,

of a poor quality and generally covered with dwarf spruce; a growth which has sprung up since the great Miramichi fire, which devastated so much of the Province fifty years ago.

The River Miramichi lies in a low wide trough, and the approaches to it from both sides are through a somewhat broken country; the railway accordingly has a winding location in descending into the valley from the northerly side where it follows the slope of the deep, crooked, steep-sided valley of a tributary.

After crossing the Miramichi and ascending the southerly slope of the valley, the railway enters on another water-shed dividing the numerous rivers, Kouchibouguac, Richibucto, Buctouche, &c., falling into the Gulf, from Salmon river and the Washademoak, tributaries of the River St. John. The land is undulating, but the ridges are higher and the earthworks heavier than on the western portion. The soil somewhat improves, but the country is wild, though important settlements are not far distant.

This District spans a remarkable carboniferous basin, forming as it does one of the most conspicuous geological features of New Brunswick. Bathurst is at one side of the basin, while Moncton is at the other, and it extends far into the interior of the country. With the exception of a narrow fringe of lower carboniferous rocks, the strata within this extensive area belong to the middle coal formation and consist chiefly of greyish sandstone and shales in horizontal strata. Only a few thin seams of coal have yet been found.

On the south side of the Bay Chaleur, two coal seams, of only six and eight inches respectively, crop out; another, about two feet in thickness, occurs at Grand Lake, some distance to the west of the railway. Other seams have been reported, and there are reasonable grounds for supposing that "boring" to a considerable depth near the middle of the basin would develope workable beds of coal, near the line of railway.

Near Bathurst a stratum of shale contains nodules of vitreous sulphide of copper. An attempt to work this deposit has been made.

Southwesterly from Moncton, near Hillsborough, the remarkable mineral "Albertite," so valuable for gas making, is found and profitably worked.

Although the railway runs along a succession of water-sheds, the country is not in any place very elevated, the highest point being 514 feet above the sea.

The District ends at Moncton, the "Bend of the Petitcodiac." Here the railway between St. John and Shediac is met, and at this place large workshops and offices have been erected.

The District Engineer, until the railway was transferred to the Department of Public Works, was Mr. Alex. L. Light. Previous to 1869, Mr. W. H. Tremaine had charge of the surveys.

DIVISION O.

CONTRACT No. 16.

This Division has a course mainly due south, there is only one curve on the line, about 1600 feet long and of long radius. The work throughout was light, and the grades in general are easy; some, however, rise 1 in 100, but the longest is only 1½ miles long. They generally rise towards the south; those descending towards the south have a total fall of 72 feet, and those ascending, have a total rise of 484 feet; the greatest difference of level between any two points being 412 feet; this difference being at the extreme ends.

The line being on or near the water-shed, the culverts and bridges are neither large nor numerous. The number, however, which would have been required, was considerably reduced by extensive ditching along the line of railway, the ground being peculiarly suitable for this work. There are, however, several large open culverts of wide span, to permit the passage of the large flow of water accumulated by the drainage works.

The only bridge on the division has three spans of 40 feet each, over the Red Pine Brook. The valley over which this bridge is built is about 36 feet deep, below formation level; but the abutments, on the side of the valley, are only about 25 feet high. The foundation is a shaly rock; the masonry is of granite, in massive blocks. Plate No. 23 shows this structure in process of construction.

The work was let, in May, 1870, to Messrs. King & Gough for $206,000, to be completed on the 1st July, 1872. During the construction of the work, the contractors and their sureties got into difficulties, and the conduct of the work devolved upon Mr. Gough alone. In March, 1874, a considerable quantity of work remaining to be executed, it was completed by the Government.

The line runs, throughout, over wild land. The length is 18½ miles; the average quantity of excavation, 18,600 cubic yards per mile, and of masonry 172 cubic yards.

The Resident Engineer was Mr. James W. Fitzgerald.

DIVISION P.

CONTRACT No. 10.

This Division is straight for the first 8 miles; nine curves are met on the succeeding part of the line; the last is nearly three-fifths of a mile long, and extends nearly ninety degrees of a circle.

The greatest difference of level between any two points on the division is that between the extreme ends, the northern part being 366 feet higher than the southern. The grades on the whole division are rather steep, several being at the limit of 1 in 100, one being 3⅓ miles long.

The cuttings and embankments are heavy. Three cuttings had 187,000 cubic yards of earth, and 65,000 cubic yards of rock. One

PLATE NO. 23.

Photo-Lith. by the Burland-Desbarats Lith. Co.

BRIDGE AT RED PINE BROOK.

(Masonry in Progress.)

embankment has 185,000 cubic yards; another, only 450 feet long, has 71,000 cubic yards; three cuttings have an aggregate of 200,000 cubic yards.

Part of the southern end of the Division is on difficult ground, on the side of a deep valley; but, in general, although the country is in some places hilly in the direction of the line of railway, it is seldom so transversely.

The line being near a water-shed, there are very few important streams. Consequently, the culverts are generally small; many, however, are long. The only bridge is over the river Bartibogue, having one span 80 feet wide, and about 30 feet high from the foundation.

The rock formations on this section are sandstone of good quality. Many of the culverts are under heavy embankments, and display excellent examples of masonry of the class shown by Fig. No. 34.

Fig. 34.

The work was let, near the end of 1869, to Messrs. McBean & Robinson for $362,083, to be completed on 1st July, 1871. Toward

the end of 1870, however, when work to the extent of $30,850 had been done, the contract was annulled. A new contract was entered into with Mr. Duncan Macdonald, to finish the work by 1st July, 1872, for the sum of $365,920. It was completed on the 10th December, 1874.

The line generally passes through wild bush-land, of poor quality; the total length is 20 miles. The average quantity of excavation is about 47,500 cubic yards per mile, and of masonry 430 cubic yards.

The Resident Engineer was Mr. Walter M. Buck, who had been engaged on the Location Surveys in 1868–69.

DIVISION Q.

CONTRACT No. 20.

This Division, though only 6 miles long, was let for the highest amount of any division on the whole railway except Division E, but the mileage rate is two and one-half times that of Division E.

About three-eighths of the Division is on curves, but the curves are not of short radius. There are two grades of 1 per 100, of an aggregate length of 3½ miles; the rest of the line is nearly level.

The cuttings and embankments are comparatively light, the deepest cutting being 24 feet, and the highest embankment about 20 feet, except at two points, where the embankments enter the Miramichi River. There is scarcely any rock in the cuttings.

The culverts are very few and small. The principal work on the division is the crossing of the two Miramichi rivers, the bridges of which are specially described.*

The contract for all the work on the Division, except the super-

* Chapter XI.

structure of the bridges, was made in September, 1870, with Messrs. Brown, Brooks & Ryan, for the sum of $642,854, the work to be completed on the 1st July, 1873. Afterwards a change was made in the plans, by which the bridge over the North-west Miramichi was to be constructed with six spans, instead of five as originally intended, and the time was extended. For the additional span the contractors were to be paid the sum of $25,000. The work was finished at the close of the year, 1875, by the original contractors.

The average quantity of excavation is about 47,500 cubic yards per mile, and of masonry, independent of the Miramichi bridges, 157 cubic yards. The bridges contain 11,082 cubic yards of masonry.

The Resident Engineer was Mr. W. B. Smellie.

NEWCASTLE BRANCH.

About a mile towards the west from the crossing of the North-west Miramichi, a branch leaves the main line and extends to deep water in the Miramichi Harbour, at the town of Newcastle. Its general course is easterly; its length 1¾ miles.

The line is almost straight for its whole length, and its maximum grade is 63 feet in a mile. At the point where the branch ends, the Government purchased the property including a wharf. This wharf has been extended a short distance into the river, and now forms a convenient landing for sea-going vessels. The rails are laid to the wharf, and extensive accommodation is afforded for shipping.

The work, including grading, ballasting, tracklaying, wharf-extension, and station accommodation, was constructed in 1872, under contract with Mr. George Perkins, at a cost of $25,123.

DIVISION R.

CONTRACT No. 21.

On this Division, 25 miles long, there are but six curves, the aggregate length of which is less than two miles. The last five miles of the Division are straight. One curve 500 yards long has a radius of half a mile; the other curves are easy.

The grades in general are light, there being but four which have an ascent of 1 per 100. Each of these is about one mile long. The greatest difference of level between any two points is 256 feet, these points being 16 miles apart.

There are but two places where the cuttings and embankments are heavy; the first is between the 11th and 15th miles, where the cuttings amount to 64,000 cubic yards of rock and 50,000 cubic yards of clay, and the embankments to 279,000 cubic yards. There is also a river diversion with 7000 cubic yards of rock and 8000 cubic yards of clay. The second is between the 19th and 21st miles where two cuttings amount to 26,000 cubic yards of rock, and 33,000 cubic yards of clay; and a river diversion at the same place, where 7000 cubic yards of rock and 3000 cubic yards of clay have been excavated. The embankment between the two cuttings contains 150,000 cubic yards.

The masonry is light; there are but three bridges, each with a single span; one 100 feet wide, the other two being 80 feet. The foundations of the latter are on rock, attained at a depth of a few feet below the beds of the rivers; that of the first is hard clay at a depth of about 20 feet below the surface of the adjoining ground. The river had to be diverted for this bridge, the bottom at the original crossing being a mixture of quicksand and clay. The diversion is about 10 feet deep, made through gravel.

The three bridges referred to are over the Barnaby river and one of its branches; the course of the river is very winding, and crosses the

PLATE NO. 24.

Photo-Lith. by the Burland-Desbarats Lith. Co.

BARNABY RIVER TUNNEL.

railway at two points besides those just mentioned. At the first a tunnel about 115 feet long, and an open cutting at each end has been constructed through solid rock for the passage of the river. The total length of open cutting and tunnel is about 700 feet, the width is 20 feet, and the height of the tunnel is 20 feet: the rock being solid it was not necessary to line the tunnel. A culvert to perform the duty of this tunnel would have been under 40 feet of embankment, about 140 feet long, and would have greatly exceeded the tunnel in cost. This tunnel is shown in Plate No. 24.

At the last crossing of the Barnaby river there is an arch culvert 16 feet wide, built on rock in the line of a diversion, about 1000 feet long. The diversion is 4 feet deep, in rock throughout its length, and the rock is so solid, that where the culvert is built, the abutments stand on top of the rock and not on the level of the bottom of the diversion.

Another large structure is a segmental arch over the Kouchibou-

Fig. 35.

guac river. It is built under an embankment 60 feet high, and is consequently nearly 200 feet long. There are no abutments of masonry, the river is diverted into a rock channel, and the arch 30 feet wide, springs off the sandstone rock. Fig. No. 35 is from a photograph of the arch before the heavy embankment was carried over it.

Near the 22d mile on the Division, there is a large bog, part of which was wet. The railway has a low embankment about 5 feet high over it. Where the bog was moist, a layer of trees was placed to receive the embankment: the bog sank two or three feet under the superincumbent weight, but the surface remained intact: the ground outside the railway line was in no way disturbed. The embankment is now quite firm.

Near the 10th mile, the railway is carried across a shallow lake, the water having been drained by long and wide side ditches. Near the same place the railway is formed over high bog, on a platform of trees; the bog sank a little, but the work is firm.

The work was let to Mr. Patrick Purcell in 1870, to be completed on 1st July, 1872; the work was finished in November 1874.

Nearly all this Division is wild land, much of it marshy and boggy; there are several settlements on good land near to the Kouchibouguac and Barnaby rivers. The valley of the Barnaby river, from the railway to the Miramichi, contains some excellent land.

The length is 25 miles; the average quantity of excavation is about 32,000 cubic yards per mile, and of masonry 269 cubic yards.

The Resident Engineer was Mr. F. J. Lynch.

At 700 yards from the beginning of the division, a branch, about 9 miles long, runs to the town and Port of Chatham, on the east side of the Miramichi. It is under construction by a private company, and almost complete.

DIVISION S.

CONTRACT No. 22.

With the exception of a curve 1700 feet in length, the railway is carried on tangents 30½ miles in length, extending 8 miles into the adjoining Division.

The grades are easy; a few rise 1 in 100, only one extending somewhat less than 1½ miles. The difference of level between the highest and lowest points, is 171 feet in a distance of 7½ miles.

The cuttings and embankments are light. An embankment at the river Kouchibouguacis, near the beginning of the Division, contains about 40,000 cubic yards; another at the river Richibucto, about the middle of the Division, contains 105,000 cubic yards; and another 67,000 cubic yards. Two cuttings, one on each side of the river Richibucto, held about 14,000 cubic yards of rock and 56,000 cubic yards of clay. Another held 17,000 cubic yards of rock and 23,000 cubic yards of clay. Additional borrowing was, however, required for the embankments.

There are seven bridges, four with one span each; one of 80 feet, another of 30 feet, and two of 24 feet. Of the three larger bridges, one has three spans of 50 feet, and the other two, have each three spans of 40 feet.

The streams at the two last bridges are very rapid, in consequence of which, extensive protection works were provided. The masonry throughout is built of sandstone.

At the bridges last referred to, over the North and South Coal branch rivers, coal and bituminous shale have been found.

The work was let in December, 1870, to Messrs. C. Cummings & Co., to be completed by 1st July, 1872, for $331,000. At the end of the latter year, the work, being not more than one-half done, was taken out of the hands of the contractors, and completed by the Government in the Spring of 1875.

All this Division is in wild forest land. Its length is 25 miles. The

average quantity of excavation is about 29,100 cubic yards per mile, and of masonry 270 cubic yards.

The Resident Engineer was Mr. W. J. Croasdale, who was succeeded by Mr. Charles Blackwell.

DIVISION T.

CONTRACT No. 23.

This Division is almost straight; there are but four curves of ample radius. The difference of level between the highest and lowest points is 300 feet; the grades are generally steep, most of them ranging between 0.75 in 100 and 1 in 100, there being seven subordinate summits.

The cuttings and embankments are generally light; one embankment, however, contains about 75,000 cubic yards. The adjoining cutting amounted to 60,000 cubic yards, in part rock.

Some trouble was experienced from one of the embankments having slipped. About 60,000 cubic yards of material were brought by train to make good the deficiency.

There are two extensive wet bogs, but the road has been successfully formed across them. A layer of whole trees with their branches was placed in the direction of the line of the railway; and another layer transversely, the butts being at the outer sides of the railway line. The embankment was then formed and stands well.

The masonry is light; the culverts are nearly all small, and there is only one bridge, over the North river. It has a span of 50 feet on a rock foundation.

The work was let in December, 1870, to Messrs. Sutherland, Grant & Co., for $276,750, to be completed by 1st July, 1872. It was eventually taken out of the hands of the contractors and finished by days' labour, by the Government, early in 1875.

The first engineer in charge of this division was Mr. Collingwood Schreiber. In 1871, Mr. Charles Blackwell was appointed.

CHAPTER XI.

THE MIRAMICHI BRIDGES.

Location of the two Bridges—Original Design—Borings—Great depth to bed-rock discovered—Engineering Opinions—Original Design adhered to—The South-West Bridge—The North Abutment—General Description of Pier Foundations—Pier E—Pier F—Pier G—Pier H—Pier I—South Abutment—The North-West Bridge—Borings—Pressure Experiments—Modified Plan of Foundations—The South Abutment—The North Abutment—The Caissons for Piers—Pier X—Difficulties met with—Pier D—Pier C—Pier B—Pier A—Concrete—Masonry—Plant—Contractors—Engineers—Completion.

After the River Miramichi had been carefully surveyed, it was decided that the Railway should cross two miles above the point of junction of the northwest and southwest branches; here the Northwest Branch is 1350 feet wide, and the Southwest 1600 feet. The range of ordinary tides is about five feet; but that of extreme tides is more than ten feet. Tidal influences extend up the two rivers some fourteen miles above the points of crossing. Owing to the presence of shoals, especially in the Southwest River, navigation is difficult for sea-going vessels beyond the junction of the branches.

The town of Newcastle, the port for vessels of deep draught, is situated below the confluence of the two Rivers, and a branch Railway 1½ miles in length, has been constructed from the main line to the deep water terminus at that place.

It was originally designed that the Northwest should have five, and the Southwest Branch six spans of 200 feet; but it was found expedient to make the Northwest bridge of six spans. Thus both structures have precisely the same water-way, 1200 feet.

The first survey led to the opinion, that rock was met in both rivers at a depth of from 45 ft. to 50 ft., under extreme high tide; that

the actual depth of water varied from 15 to 33 feet; and that the bed of both rivers consisted of silt from 17 to 30 feet deep.

The plan originally adopted for the foundations was to construct them of huge caissons filled with concrete. The lower part of the caisson was to be a chamber, designed in the form of an inverted hopper, to admit of undermining and of dredging operations; each chamber being accessible by a shaft. During the work these shafts were designated "wells," which indeed they resembled; and it was through them that the silt, when removed by dredges, was lifted to the surface. It was designed that the caissons, when undermined, should sink through the silt of the river bed to the rock; and that, when finished, they should be brought to the level of six feet under low water, and be entirely filled with concrete; thus giving a solid foundation to the masonry. It was originally determined, that the Southerly abutments of both bridges should have their foundations on these concreted caissons; and that the Northerly abutments should be built, in the ordinary way, on the dry land of the two shores.

When the work described was placed under contract, and operations were commenced, it was discovered that the stratum immediately under the silt was not rock, as supposed, but a bed of gravel, more or less compact, and of varying thickness, overlying a thick deposit of sand and silt in the northwest river, and of clay in the south west. It was found that the average depth to the bed rock under high water, was, in the Northwest branch 112 feet, and in the Southwest 90 feet, instead of less than half these depths as at first believed.

After careful investigation, the Engineer did not consider it necessary to incur the enormous expense involved in the carrying of the foundations to the bed-rock of the River. He satisfied himself that it would be sufficient to sink the caissons to the depth of the gravel stratum which formed the hard substance assumed to be rock when the preliminary survey was made. He did not deem it expedient to change in any way the contract plans for the Southwest Bridge; but he thought it advisable to make some modification in the designs for

PLATE NO. 25.

Photo-Lith. by the Burland-Desbarats Lith. Co.

that of the Northwest. In this case he proposed another span, so as to throw the southerly abutment upon the river bank, and thus secure a rock foundation, relieving the comparatively thin gravel bed, and the other strata forming the bed of the river, from the weight of the high embankment which formed part of the original plan. He also considered it prudent to enlarge the base of each pier, in order to distribute the super-incumbent weight over a greater supporting area.

The Chief Engineer announced to the Commissioners the decision he had come to.

The latter, however, in view of the magnitude of the work, referred the matter to two other Engineers, Messrs. Samuel Keefer and C. S. Gzowski.

These gentlemen reported against the plans of the Chief Engineer and expressed a strong opinion adverse to the practicability of carrying them out. At the same time they brought forward a design their own, which they recommended the Commissioners to adopt.

The plan proposed appeared to the Chief Engineer to be open to grave objections; and he advised the Government not to hazard its adoption.

After several communications had passed on the subject between Jan. 13th and March 9th 1872, the Government finally passed an order in Council, sustaining the views of the Chief Engineer, and throwing upon him the responsibility of carrying into execution his own plans.

THE SOUTHWEST BRIDGE.

It has been stated that the original borings, made during the preliminary survey of 1868, led to erroneous conclusions respecting the river-bed. The only tools and appliances which could then be obtained, were imperfect and not well adapted for ascertaining, with accuracy, the character of strata at a considerable depth under water. The consequence was, that a hard substance met with, at from 40 to 50 feet under high water, was assumed to be a continuation of the rock formation, which cropped out on the banks of the river.

During the winter of 1870–1, more perfect implements were used, and the discovery was made that the hard stratum was only a bed of gravel and that the true bed-rock was, in the southwest river, some 50 feet lower than it was previously believed to be. Plate No. 26, shows the relative position of the several strata which underlie the river.*

* The following is an abstract of the borings made at the several piers and abutments subsequent to 1870:

AT FACE OF NORTH ABUTMENT.

Water,	5′ 4″	
Sand,	1 6	
Tough brown clay,	41 5	
Rock at	48′ 3″	Below datum.

AT CENTRE OF PIER E.

Water,	26′ 9″	
Sand,	18 10	
Gravel,	2 0	
Tough brown clay,	34 6	
Rock at	77′ 1″	Below datum.

AT CENTRE OF PIER F.

Water,	22′ 4″	
Sand,	21 8	
Gravel,	7 10	
Tough brown clay,	41 7	
Rock at	93′ 0″	Below datum.

AT CENTRE OF PIER G.

Water,	14′ 7″	
Sand,	30 5	
Gravel,	7 10	
Tough brown clay,	43 0	
Rock at	95′ 0″	Below datum

AT CENTRE OF PIER H.

Water,	13′ 10″	
Sand,	34 8	
Gravel,	6 2	
Tough brown clay,	42 4	
Rock at	97′ 0″	Below datum

AT CENTRE OF PIER I.

Water,	16′ 8″	
Sand,	31 0	
Gravel,	5 8	
Tough brown clay,	42 8	
Rock at	94′ 9″	Below datum.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The Chief Engineer, nevertheless, decided to carry out the original design, and to sink the caissons of the piers down to the gravel bed, and that of the south abutment to some distance into the underlying clay.

The work has been accordingly carried out as shown in the drawings. The north abutment is at the river's edge. The south abutment stands about 300 feet from the shore, an earthen embankment connecting it with the river bank.

THE NORTH ABUTMENT.

When the north abutment was proceeded with, the foundation for the front wall was excavated to the depth of 16½ feet below high water, and the area filled with concrete to a depth of eighteen inches. The foundation for the wing walls was stepped back, as shown on the drawings, plate No. 29.

The masonry was commenced on the 27th July, 1871, the foundation stone being laid by the Chairman of the Commission, Mr. Aquila Walsh, on the 3d of August. The work was continued until the end of November, when a few stones only were wanted in the parapet walls to complete the structure.

THE PIERS.

The five piers are lettered E, F, G, H and I; they are placed at the points indicated on the drawings; E being next the north abutment and I nearest the southern side of the river.

The following table gives the depths, to the supposed rock, from

AT SOUTH ABUTMENT.

	Face.	Centre.	Back.
Water,	17′ 2″	17′ 4″	17′ 4″
Sand,	6 0	5 0	5 8
Sand and Gravel,	1 0	2 0	1 0
Mud and Vegetable Mould,	8 9	5 8	2 6
Gravel,	1 4		
Tough brown clay,	43 9	45 0	47 8
Rock at	78′ 0″	75′ 0″	73′ 4″

the preliminary borings; to the gravel bed, from subsequent borings; and also the depths to which the caissons have been actually sunk.

Site of Pier.	Depth to supposed rock from preliminary borings.	Depth to gravel bed from subsequent borings.	Depth to which caissons were actually sunk.
Pier E,	44 feet.	40.6 feet.	40.2 feet.
" F,	44 "	43.6 "	44 "
" G,	41 "	45. "	45 "
" H,	49 "	48.5 "	49 "
" I,	41 "	47.2 "	47 "
Mean,	43.8 feet.	45.0 feet.	45 feet.

The original design for the foundations of the piers, as shown in Plate No. 27, was adhered to; and as all the five cases were alike, a brief description of one will suffice.

The foundation works consisted, essentially, of a large caisson formed of hewn timber and water-tight planking; the top dimensions 73 feet by 17 feet were constant, the bottom varying according to depth. The caisson was divided into compartments, all of which, except the lower ones, designated "bottom chambers," were filled with concrete as the work proceeded.

The bottom chambers were left for the purpose of excavating underneath the caissons, either by dredges, steam pumps or divers; they communicated with the open air by means of vertical shafts or wells through which the excavated material was elevated. The bottom chambers, as the drawings show, were constructed like inverted hoppers, terminating in a cutting edge formed of hardwood timber and boiler plate.

As the material underneath was removed the caissons were sunk until they reached the required depth; the bottom chambers and the shafts leading to them were then filled in solid with concrete, from the cutting edges to the surface.

For the purpose of building the masonry, coffer-dams were attached to the tops of the caissons, but so as to be removable when the piers were completed. In order that they should extend above high water, they were from 12 to 14 feet deep. They were made of such strength as

ND ELEVATION.

when pumped out, would resist the pressure of the outside water, and they were thoroughly secured to the caisson. The outsides were covered with three-inch planks, put on with close water-tight joints.

PIER E.

The first of the caissons built was that for pier E. It was commenced on the 12th of June, 1871, and when the building was sufficiently advanced it was launched on the 17th of August. A staging upon piles driven into the river bottom was erected around the site of the pier, forming a platform along both sides, and across the down river end, the upper end being left open. Into this space the caisson was floated, the building proceeded with, and finished, to the full height of 30 feet, before any concrete filling was done.

The depth of water at the site of the pier was 26 feet 9 ins. and it was required to sink the caisson to the depth of 43 feet, or 16 feet 3 ins. below the bed of the river.

The filling of the compartments with concrete was begun on the 14th of September, and proceeded at the rate of 20 cubic yards a day. The caisson settled down gradually. By the end of October the compartments were filled and the caisson had sunk 2 feet 9 inches into the bed of the river.

Two Woodford "Dredge Pumps" were then put in operation for the removal of the underlying material; they continued at work up to the end of the season, during which time the caisson sank a farther depth of 2 feet.

Work was resumed on the 21st of May, 1872, but the progress made with the pumps was so slow that it was determined to substitute dredging machinery. Frequent interruptions arose from sunken logs and branches, which had to be removed by divers. Nevertheless by the 20th of June a further depth of 5 feet had been obtained.

When the dredges commenced operations the cutting edges stood 36 feet 6 inches below high water. It was soon discovered that the

caisson was passing through a heavier description of material than what had been anticipated. It consisted of gravel mixed with clay, and was so compact that the dredge buckets made little impression upon it. It therefore became necessary for divers to excavate, by pick and shovel, the material from beneath the cutting edges, and to remove stones by hand. This subaqueous work was very tedious, and it was only after a month's incessant labour, that the caisson finally obtained a level bearing 2 feet 9 inches higher than at first intended.

To give the caisson additional weight to aid it in sinking, it was arranged that the material dredged out of the chambers should be deposited within the coffer-dam, the wells having been continued to the top of the coffer-dam by temporary planking.

The chambers and wells up to the proper level were filled with concrete. On the completion of this work the dredged material was removed from the coffer-dam preparatory to laying the masonry. When the coffer-dam was pumped out, there being very little leakage, the water was perfectly under control, and in no way impeded building operations.

The masonry was commenced at 11 feet 6 inches below high water level. It was begun on the 3d of October 1872, and during the season was carried to the top of the cut-water, 6 feet above high water mark.

Work was resumed on the 12th of May 1873, and the pier was completed on the 18th of June following.

PIER F.

The caisson for this pier was ready for launching with the high tide in the middle of September 1871.

The depth of water was 22 feet 4 inches. The top of the gravel bed was found at 43 feet 7 inches. The depth required to be reached was fixed at 44 feet below high water.

On the 31st of October the concrete filling was begun, and con-

tinued to the end of the season, at which time the caisson had settled about a foot into the sand.

During the winter a scour took place around the up-river end of the caisson, which had the effect of lowering it a further depth of 5 feet.

Work was resumed on the 12th of June 1872, and after some concrete filling had been done, the caisson was brought to a horizontal bearing by the operations of a Woodford pump, and the cutting edges lowered to 31 feet below high water.

The dredge towers were then erected and carried directly upon the top of the coffer-dam lending their weight to the sinking of the caisson. Fig. No. 36 shows the dredging machinery in position.

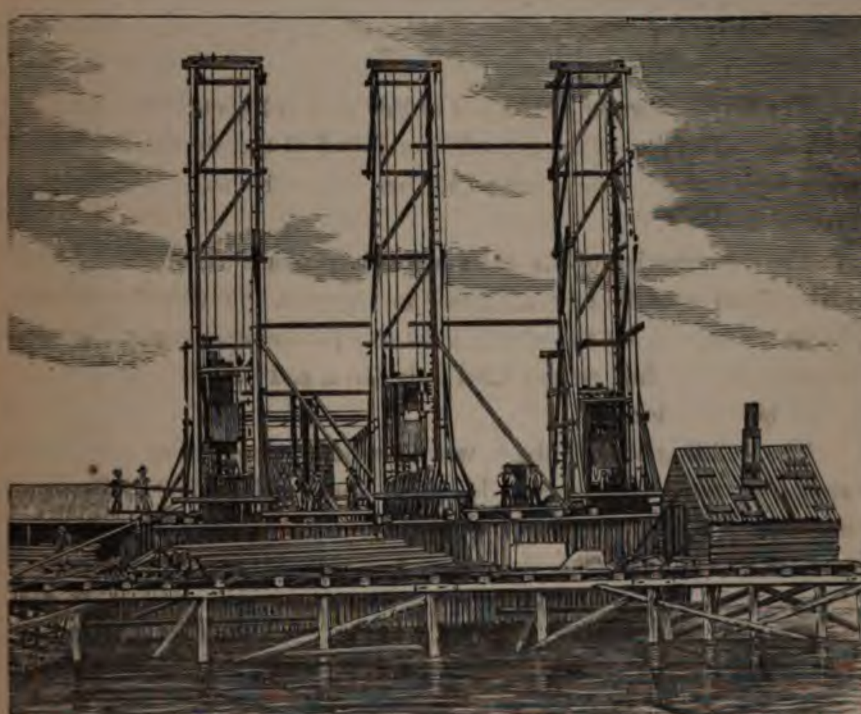


Fig. No. 36.

On the 17th of September the dredges commenced operations; the caisson sinking gradually. Meeting with no obstructions, it reached the required depth on the 25th of the same month. During the following month the bottom chambers and wells, were filled with concrete to within 6 feet of the top. The work was stopped for the season on the 1st of November.

Work was resumed on the 5th of May 1873, the concrete filling was completed and the coffer-dam pumped out. There was a considerable leakage in this dam, probably from the fact that it was exposed to the action of ice. Two pumps were required to permit the lower courses of masonry to be laid.

The laying of masonry was begun on the 15th of May, and was completed on the 21st of July, 1873.

Pier G.

The depth of water at the site of this pier at high tide was 14 feet 7 inches. The top of the gravel was found at the depth of 45 feet below high water. The caisson had therefore to be sunk over 30 feet through the sand.

The construction of the caisson was begun on the 18th of September 1871 and considerably advanced in October. It was deemed advisable to leave it on the stocks until the following summer. It was successfully launched on the 23rd July 1872, and two days afterwards floated into position.

The building of the caisson was suspended when it had reached a height of 22 feet. No further building was done until the 26th of September, when the concrete filling was begun. There being only about 8 feet of water in the compartments at low tide, advantage of this was taken to have the concrete in the compartments deposited about the time of low water, and consequently, most of it had time to partially set in the air before it was subjected to the action of water.

By the 12th of October, the filling of the caisson, to the extent it was built, was completed. It was then necessary that the dredging

COLONIAL RAILWAY.

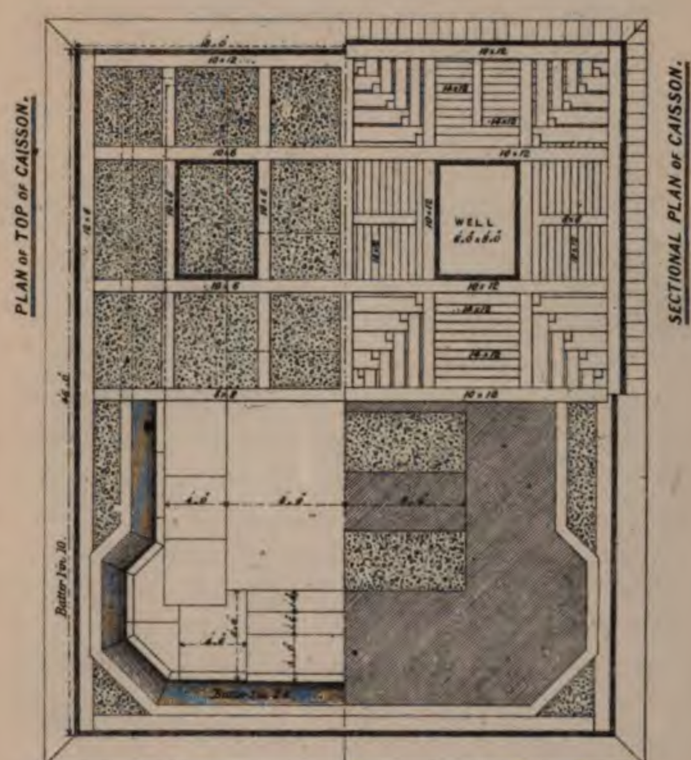
RAMICHI BRIDGES.

SSON AND MASONRY OF SOUTHERLY ABUTMENT

SOUTH-WEST BRANCH.

andford Fleming, *Engineer-in-Chief.*

SCALE



PLAN OF TOP.   PLAN OF FOUNDATION.

Photo-Lith. by the Burland-Desbarats Lith. Co.

should be commenced before the building could be continued. To enable the dredges to work, and at the same time admit the other operations to be proceeded with, it was necessary to erect a strong frame to carry the dredge towers, at some height above the floor of the general platform. The work of sinking the caisson was resumed early in June 1873, and by the 18th of the month, the cutting edges had reached the required depth of 45 feet below high water.

In removing the dredged sand from the coffer-dam it was found that the quantity of water coming in was so great that two steam pumps were required to keep it under control during the laying of the first courses of masonry. The masonry was begun on the 25th of July, and completed on the 15th of September 1873.

Pier H.

The depth of water at high tide at the site of this pier was 13 feet 10 inches.

The depth to the gravel bed on which the caisson had to rest was 49 feet.

Construction of the caisson was commenced early in June 1873. It was launched on the 10th of July, and floated into position on the 15th. The filling with concrete was continued up to the 21st of August, at which time the caisson was 24 feet high and had settled 2 feet 6 inches into the river bottom.

The dredges commenced operations on the 14th of October. On the 1st of November the depth of 35 feet was reached ; and the work was then closed for the season. Operations were resumed on the 23d May, 1874, and continued until the 23rd of June, when the full depth of 49 feet was reached.

After filling up the caisson with concrete, one steam pump was sufficient to keep the water under control.

The setting of masonry began on the 11th of August, at 14 feet below high water, and the pier was finished on the 28th of September 1874.

Pier I.

The depth of water at high tide at the site of this pier was 11 feet 8 inches. The depth to the top of the gravel bed was 47 feet below high water; the height of the caisson had therefore to be 33 feet.

The caisson was commenced on the 21st of July 1873, on the 10th of September it was floated into position, and soon afterwards concrete filling was proceeded with.

A scour having taken place at the up-river end, the caisson was brought to a horizontal bearing by means of the pumping machinery, and the weak points protected by rip-rap. Work was suspended on the 14th of November, the cutting edges then standing 20 feet 6 inches below high water.

Work was resumed on the 9th of June 1874, and Woodford pumps were used to lower the caisson, until on the 29th of July the dredges were ready for work. The operations were then continued and after sundry interruptions, the caisson reached the required depth on the 6th September.

The Chambers and wells were filled with concrete as in the other piers; and on the 29th, masonry was commenced. The leakage of the coffer-dam, in this case, was so considerable, that two steam pumps were required to keep the water sufficiently low. The masonry was completed on the 31st of October.

South Abutment.

This abutment was about 300 feet from the shore, with a depth of water at high tide at its site of 17 feet 4 inches. It was necessary that the caisson should rest horizontally and therefore that the cutting edges should be sunk into the brown clay which the borings showed as lying 26 feet below high water at the back of the abutment and 34 feet at the face. The sinking to the necessary depth was tedious and expensive.

PLATE NO. 30.

Photo-Lith. by the Burland-Desbarats Lith. Co.

SOUTH-WEST BRIDGE—RIVER MIRAMICHI.

The foundation works were similar to those already described, except that the caisson had four wells or chambers through which the silt was removed.

The construction of the caisson was begun about the 1st of September 1872. When it was floated into position, the building was carried on until the 31st of October, when work was suspended for the season.

The building was resumed on the 7th of June 1873, and finished shortly after. During the winter a scour took place around the North-west corner, which gave a depth of 20 feet below high water and the caisson settled accordingly. Before proceeding farther, it was necessary to bring the caisson to a level bed; and therefore the sunk corner was supported by a couple of 2 inch iron rods from a truss resting on the surrounding staging: the iron rods having long adjusting screws. Towards the end of June the caisson was brought to a level. When the clay was reached, the sinking became very slow. The clay was too hard to be excavated by the dredges and had to be excavated by hand by the divers with pick and spade. This labour had to be carried on to the depth of 8 feet at the back of the abutment, but to a less depth along the front and sides. It required the constant exertions of two divers and a large number of other men for two months.

By the 6th of October, the front of the caisson was brought to rest on the clay, with horizontal bearing throughout. When building commenced, the water coming into the coffer-dam was kept under by one steam pump.

The masonry was begun on the 21st of October, and continued to the 13th of November, at which period, the masonry had reached 6.5 feet under high water, and further work was suspended.

At this time the heavy earth embankment had approached close to the abutment. During the winter the material was tipped over the front and sides of the coffer-dam, till it appeared above the surface of the water.

The false works were destroyed during the winter, but were

restored in the spring of 1874. The masonry was completed on the 6th of August of the same year.

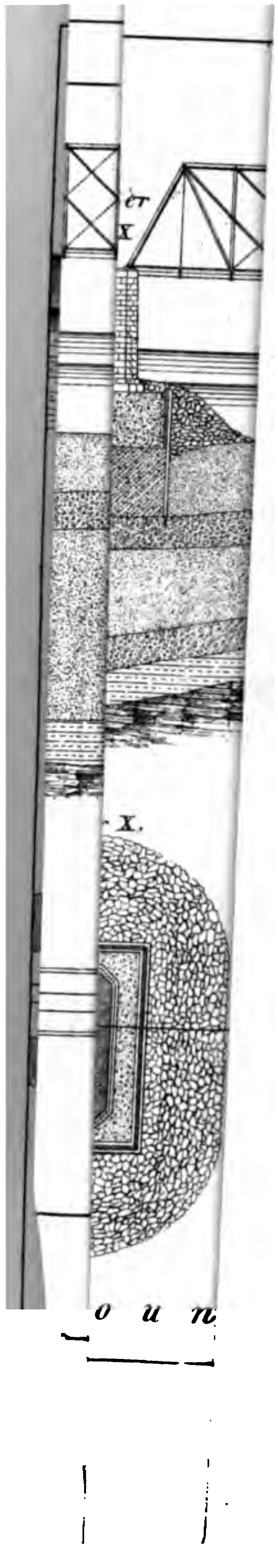
The embankment was formed around the abutment, and the slopes and sides covered with rip-rap, three feet thick, from the bed of the river to five feet above extreme high water.

THE NORTHWEST BRIDGE.

It has already been stated, that the first design for the North West Bridge was similar to that for the South West; the chief difference being in the number of spans. The northwest structure was to have had five spans, each 200 feet wide; while the other was designed to have six spans of the same size. It has also been explained, that the first survey led to a misconception with regard to the strata in the bed of the River; that, instead of rock being found at an average depth of 48 feet under high-water, the hard substance struck by the boring tools was only a bed of gravel overlying a great deposit of silt, and that the rock was actually 112 feet below high water.

It is necessary to state, that, when the oreliminary survey was made, only such boring implements could be obtained; as could be extemporized in the neighbourhood by a country blacksmith, and that with these imperfect implements the attempt was made to ascertain the nature of the river bottom. The bed of the river was from twenty to twenty-five feet below high-water; and after the boring rods had passed through about the same extent of mud, they, in every trial, struck a hard substance. The operator saw sandstone rock cropping out on the river bank; and he naturally, but as it afterwards proved, incorrectly, inferred, that he had struck a continuation of the rock formation, underlying the river.

During the winter of 1870–1, more perfect boring implements were employed in testing the nature of the river bottom before building operations were commenced. It was then that the true nature of the river bed was discovered.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A series of accurate borings was then instituted. These borings were made from scows during the summer of 1871; and from the ice during the following winter. The site of each pier was carefully established: and besides the test borings on the centre line, others were made on parallel lines 50 feet distant on each side of the centre line. The results did not materially differ from those obtained on the centre line, and showed that the strata were horizontal.

The boring was performed in the usual manner, 7-inch tubing being used. Some arrangement was, however, necessary to meet the difficulty which the rise and fall of the tide presented when operating from the ice, in order that the tube should be maintained vertical and steady and free from all liability to derangement, as the ice rose and fell. A wooden tube or box, 9 inches square inside, and of sufficient length to extend beyond the range of tides, was sunk through the ice, and had arms which rested upon and were made fast to the surface. This box protected the upper end of the iron tubing from the ice, while itself rose and fell with the tide. When operating from a scow, a well through the floor of the scow served the same purpose. On reaching a suitable depth a smaller tube—5 inches diameter—was introduced, telescopic fashion; care being taken that the upper end of the smaller tube did not fall below the bottom of the larger one. The point of the tubing was in all cases made to precede the point of the valve auger or other boring tool in use, and thus the exact depth and character of the various strata were ascertained. The results are shown on the section of the river bottom, plate No. 31.

As the boring proceeded for the northwest bridge, experiments were made to ascertain by direct pressure the load which the strata would carry. On the tubes reaching the point to be tested, and the material within having been removed, iron rods smaller than the tubing were passed down. The rods terminated in a blunt end with an area of three square inches. They were kept clear from friction, and were loaded above the surface of the water with different weights, which were allowed to remain for definite lengths of time. In this

manner the supporting power of the different strata in the bed of the river was distinctly ascertained.

The result of these tests may, possibly, possess some interest to the professional reader.*

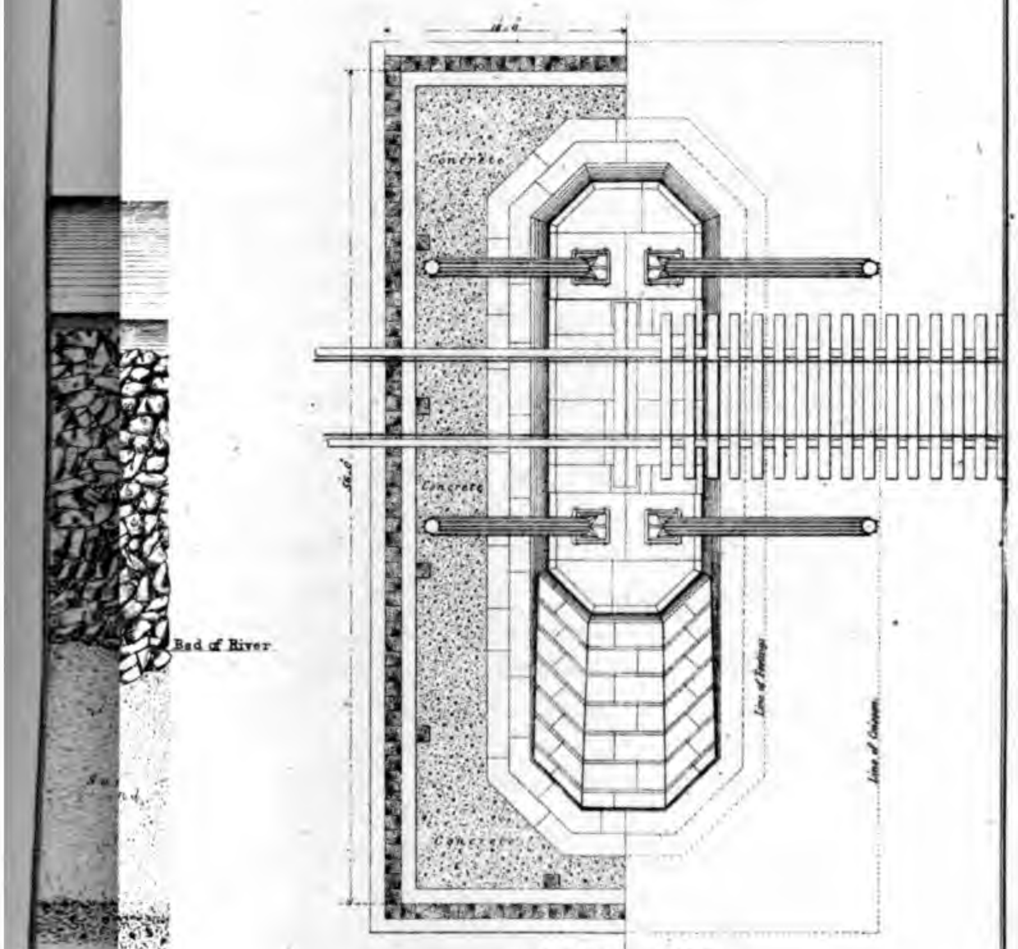
The information thus obtained having established that the piers might safely be founded on the gravel stratum, the Chief Engineer did not deem it necessary to change in any way the original plan; he, however, held it expedient to increase the width of the caissons from 24 to 30 feet, in order to distribute the weight over an area one-fourth greater than at first designed. But a difficulty arose with the contractors. They argued that an increase in the width of the base of the caissons would render the sinking of them extremely difficult; and they demanded a large increase in price for the additional labour and expense which they asserted the change would exact. To meet these objections the Engineer proposed a modification in the form of the caissons with an increased base, which the contractors undertook to carry out for little more than the original contract price.

The modified plan of foundations for the Piers, adopted and carried into execution, is shown in Plate No. 32. A large oblong caisson, open at the top and bottom, was first sunk in proper position at each pier site; its lower edge resting on the bed of the river, and its upper edges extending above water. Around the four sides were square piles driven close together. Within the enclosed area, all the sand and mud, down to the gravel bed, were removed, and the space filled with rubble stone and concrete in equal proportions. The space within the caisson, and above the original river bed, was then filled with concrete up to the bed for the masonry. The concrete thus formed a huge monolithic mass for the support of the superincumbent pier.

It has already been stated that an additional span was given to the Northwest Bridge; by this arrangement the two abutments were

* See Appendix.

PLATE No. 82.



PLAN OF PIER.

FOUNDATION. MASONRY.

Photo-Lith. by the Burland-Desbarats Lith. Co.

placed on the shore, where no difficulty was experienced in founding them.

The five piers were lettered consecutively from north to south; A. B. C. D. and X.

Plate No. 31 shows the relative position of the piers and abutments; together with the strata which underlie the River.

Fig. No. 37.

THE SOUTH ABUTMENT.

Operations were commenced on the 13th of May, 1872, at the Southerly abutment. One-half of the site lay within the water mark; and in order to obtain a foundation, a coffer-dam was necessary. This was constructed of crib work and sheet piling, and of only three sides, carrying a platform about 20 feet wide. A wharf for the discharge of building stone was formed on the front, and a travel-

ler was constructed, by which the material for building was lifted directly into position. The sheet piling within the crib work was in two rows, 5 feet apart, driven to the rock; and the space between the rows was filled in with clay puddle. The rock bottom was laid bare, and then cut into steps to receive the masonry, the front wall of which commenced 12½ feet below high water level. Little trouble was experienced from water; what little was met with, flowed in through fissures in the rock.

The masonry, 985 cubic yards, was commenced on the 13th of June, and completed on the 28th of August, 1872.

THE NORTH ABUTMENT.

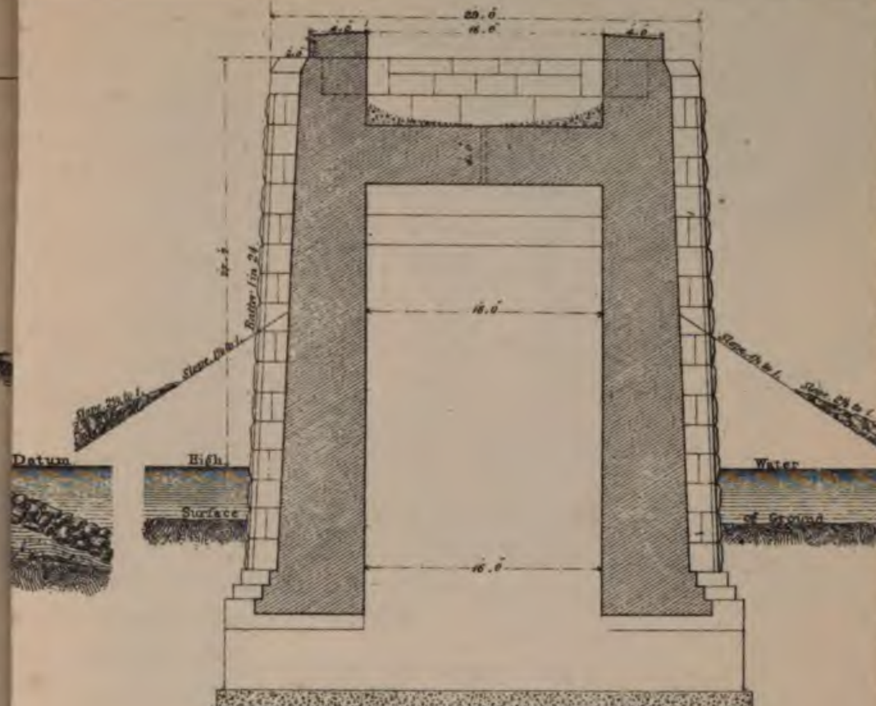
The site being entirely within high-water mark, it was necessary to construct a coffer-dam. The shore at this point is bold, and the rock dips towards the river, when, at the face of the abutment, it drops to a slope of about one to two. The whole abutment is placed on solid rock, the front wall commencing 19 feet 6 inches below high-water. The rock lay in a series of irregular benches, and was cut into horizontal steps, to receive the masonry. The coffer-dam was well constructed; and in consequence the water was controlled by one Woodford pump, driven by an engine on a scow alongside. The masonry was placed in position by a Traveller erected on the crib-work. The masonry, 1115 cubic yards, was commenced on the 15th of August, 1872, and completed in the following November. The mass of the masonry is of freestone from quarries in the locality: the girder seats are of granite, in single blocks, 6 feet by 4½ feet, and 2¼ feet deep. The upper surface is 23 feet 7 inches above extreme high-water.

Plate No. 29 shews the form and detail of these abutments.

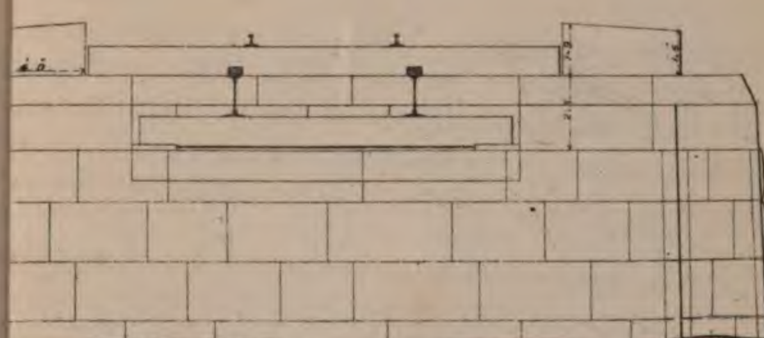
THE CAISSONS FOR PIERS.

The caissons were each 60 feet by 30 feet, built of timbers, 12

PLATE No. 29.



TRANSVERSE SECTION.



ENLARGED FRONT ELEVATION.

SCALE

Photo-Lith. by the Burland-Desbarats Lith. Co.

inches square, hewn true on their beds, halved together at the corners and breaking joints on the sides and ends. A roll of oakum was laid between the timbers, both on the flat, and at the butt joints, to render all water-tight. The timbers were fastened every 4 feet of their length, and at the butts, with juniper treenails.

The caissons were commenced on launch-ways near the Bridge site, and were built to a height of six or eight feet previous to being launched. The construction was then proceeded with, afloat, until the requisite height was obtained. The tops when in place were, in all cases, left above high-water level, as each caisson had eventually to serve as a coffer-dam.

As the caissons had to be pumped out to permit the building of the masonry, it was necessary to strengthen them internally by means of longitudinal and lateral struts and braces, which were afterwards removed.

When the caissons were floated into position, they were loaded down with stone, to hold them in place. Square piles were then driven round the four sides, to the gravel bed. The piles were each bolted to the upper timbers of the caissons, and a waling timber was secured along the outside faces, about midway between high and low tide mark.

Pier X.

Pier X was the first commenced; and as the difficulties met were here first overcome, a brief account will suffice for all the piers. The caisson for this pier was commenced on the 19th day of June, 1872. Some little difficulty was experienced in launching it, but it was eventually floated into position on the 6th July, and temporarily secured by driving a few piles on each side and end. Building was then proceeded with, and the required height was reached on the 26th. On the caisson grounding, it was found that the bed of the river was somewhat uneven, and it became necessary to level it by dredging away the inequalities and so allow the caisson to rest horizontally.

In order to sink the caisson, a platform was foamed on its top, and loaded with stone.

Two steam pile-drivers were then employed in driving the sheet piling. The piles were twelve inches square; driven, as close as possible, to a depth of 47 feet 6 inches below high water; passing 8 inches into the gravel bed, which, at this pier, is 6 feet 8 inches in thickness. The driving for the last few feet was very slow. This work was completed by the 6th of September, when temporary piles were driven for a platform 20 feet wide on each of the four sides of the caisson. On the platform a gantry was erected, of such height and length as would allow the traveller which it carried to lift building stone from the scows and set them on any part of the structure. Before commencing the masonry, the traveller was constantly in use in moving the engines and pumps employed in dredging, and in raising any sunken trees found embedded within the area of the foundations. The engines and machinery used in dredging and in pumping, were placed on the platform, which further served as a wharf for the discharge of material of all kinds.

The river bed at this pier consisted of a black vegetable deposit, fully 16 feet in depth, and a mixture of mud and sand about 8 feet deep. Two pumps, driven by separate engines, commenced operations on the 21st of September 1872, but the progress made in the vegetable deposit was very slow. The pumps simply settled down into an area a little larger than their base, while the material stood firm with nearly vertical sides. The action of water jets was brought to bear on it; and by means of this expedient, it was reduced, and ultimately removed by the pumps.

The upper layer of material contained a quantity of partially decayed wood, which continually became jammed in the working parts of the pumps, and necessitated frequent disconnecting of the machines for the removal of the obstruction. Two logs of Birch were found embedded in the deposit, 30 feet below high water. The removal of these occupied several days, as the material overlying them had to be dredged out for their whole length before they could be

moved. Eventually, chains were made fast to them by divers, and the logs were raised by the traveller overhead: one piece measured 26 feet long and 16 inches in diameter, the other 15½ feet long, and 20 inches in diameter.

The pumps continued in operation up to the 20th of November, when the formation of the ice rendered a suspension of work necessary. Up to this time a great proportion of the vegetable deposit had been removed. Work was resumed on the 5th of May 1873, and the whole material within the area of the caisson was dredged out to the depth of 46 feet below high water mark by the 31st of May.

The dredging of this foundation extended over a period of twelve weeks; but deducting for wet weather and other delays, the actual pumping occupied sixty days of two engines and two pumps.

The quantity of material removed was 1416 cubic yards; and taking the capacity of each pump at seven cubic yards (1200 gallons) per minute, it appears that a cubic yard of water carried out with it on an average 0.075 cubic feet of solid matter, or at the rate of 1 cubic yard of the deposit to 356 cubic yards of water.

Preparations were at once made to put in a 2½ feet layer of concrete over the whole area excavated. It was deposited through large spouts reaching to the bottom. Alternate layers of quarry rubble stone and concrete were evenly distributed over the area until the space was filled up to the level of the bed of the river. A layer of concrete 6½ feet thick was then put in by means of boxes with movable bottoms. These boxes were contrived to open only when they touched bottom, in order that the concrete should be as little diluted as possible, by passing through the water.

The concrete was brought to the proposed level by the middle of July; when, after a few days delay, an attempt was made to unwater the dam with two Woodford pumps; but the concrete had not sufficiently set, and the machinery was overpowered and pumping had to be postponed.

With a view to make good the defects in the concrete and to

reduce the head of water, another layer of concrete 18 inches deep was put in, which brought the surface up to 15 feet below high water.

On the 30th of July a second attempt was made to pump out the dam with two pumps, but without success. On the following day bags filled with clay were laid over the places where the leaks seemed to be greatest, viz. along the timbers of the caisson. The two pumps then, with ease, ran the water down to within three feet of the concrete, and held it there; though the leak was still considerable, and evidently was increasing. Walls of clay puddle were now built over the heaviest leaks, and a third pump introduced. On the 9th of August the three pumps were started with the falling tide, and in fifteen minutes the surface of concrete was laid bare.

This condition was maintained for some time; when, without the slightest warning, a large mass of concrete, close to the timber on the northern side, was forced up and the dam immediately filled, notwithstanding the pumps continued running. The Chief Engineer decided to make good the concrete, to add an additional layer, and defer further pumping for some months, in order to give the concrete time to harden. At the same time, with the view of securing and strengthening the caisson, he directed that heavy iron rods should be passed through from side to side, dividing it into six equal lengths, and that similar rods anchored in the concrete should be placed at both ends. All these rods were firmly tightened by nuts and screws; and as they were placed at some distance under water, divers in ordinary waterproof armour were employed. Rods such as described were placed in all the other piers.

The work was not proceeded with in winter, but was resumed on the 11th of May 1874. Two pumps were then started, the water was speedily lowered to the concrete which proved hard and solid. The leaks between the concrete and the timber were still considerable, but there was no appearance of leak through the body of the mass. In putting in the concrete in July 1873, wells were left at each corner into which the pumps were set. It was considered that much of the leakage came in at these points; and on the additional layers of concrete being

put on, the wells were filled up. As the Woodford pump requires water at least 12 inches deep in order to work with advantage, the concrete could not be laid quite bare, and the first course of footings—2½ feet deep—was set partly in water. Any irregularities in the surface were removed by making up the concrete to a uniform level, so that every block had a solid bed. That the water might be entirely under control at any state of the tide a second engine and pump were put in position. The first course was set by the 18th of May.

There was no further difficulty in keeping the dam free of water, and the masonry soon rose above the surface; but all anxiety was not removed.

It was discovered at the end of June that the foundation of the structure, since the commencement of the masonry, had settled about six inches. Accurate measurements were regularly taken, and it appeared that a gradual settlement was going on. The building of the masonry was continued until the 6th of July, when the work was suspended, the pier being then four feet from the required height. Up to the 29th of August, the work had settled in all ten and a half inches. It was now determined to place on the pier a load several hundred tons greater than, on the completion of the bridge, it would be required to carry, and thus by direct weight force the whole structure to a permanent bearing. This course was the more called for as doubts had been strongly expressed as to the sufficiency of the strata, underlying the river, to carry the bridge. For this purpose a platform was built on the footings of the masonry; upon this and the unfinished pier, stone and rails to the weight of about 450 tons were placed. Up to the 3d of October, under this load, a further depression had taken place of 2½ inches. The work remained thus loaded until the following spring, when another 100 tons were added, but no farther settlement was perceptible. Fig. No. 38 shows the pier partially loaded.

Careful investigation showed that the close piling around the concrete had not been disturbed in any way; that each pile remained precisely in the same position as when first driven; and that

Fig. No. 38.

the gravel stratum which supported them had not yielded in any way. The settlement was therefore wholly within the caisson; and was undoubtedly due to the compression and consolidation of the stone filling below the concrete, under the load which had been built over it. It was evident from the fact that the masonry was without the slightest sign of crack or flaw, that the concrete had a monolithic character, and had gradually sunk *en masse* as the material under it became compressed by the superincumbent weight.

When the structure was completed, and the false works removed, the sheet piling and dam were cut off below low water level, and a mass of rip-rap deposited, as shown in Plate No. 32, so as entirely to cover and secure the whole of the works on which the masonry rests. The rip-rap was allowed to take a natural slope, and was rounded at the up and down stream ends to reduce the effects of any cross-cur-

rents produced by the obstruction of the stream; and to obviate, as far as possible, the chances of a scour.

PIER D.

The foundation caisson, as constructed, is as that for Pier X. It was launched on the 9th August, 1872, and moved near to the site of the pier. The building continued till the 16th of October, when it had attained the required depth of 30 feet. On the following day, and while the tide was running out, the caisson broke from its moorings, but it was recovered without being damaged. It was loaded and sunk, and the driving of the sheet piling commenced: but when the works were closed for the season on the 20th November, the piling was not completed. In this case the piling was driven to the depth of 43 feet below high water level.

The work was resumed on the 6th of May, 1873, and by the 1st of June, the sheet piling and the piling for the surrounding platform were completed, and the plank and machinery placed in position. The dredging, carried on as in the last pier, was commenced 5th of June, 1873. The material, a clean coarse sand, yielded readily to the action of the Woodford pump; the result accordingly differed from that at pier X. The depth of the sand was over 11 feet, and the excavation measured 700 cubic yards.

By the 18th, the dredging was completed to the depth of 41 feet under high water; and although it extended over fourteen days, only 10½ days were employed in actual pumping, with two engines and pumps. The capacity of each pump being twelve hundred gallons, or seven cubic yards per minute, a cubic yard of water carried with it 0.21 cubic feet of sand, *i.e.*, 1 cubic yard of sand was removed with 126 cubic yards of water.

The concrete filling was completed by the 25th September. No masonry was, however, laid that season.

On the 21st of August, 1874, an unsuccessful attempt was made

to pump out the coffer dam. On the 24th, a second attempt was made; but the water could not be lowered more than 11 feet below high water with the pumping power employed. An additional engine with pump being put in operation, the water was run down sufficiently for the first course of masonry to be started. The stream of water discharged was at least 7000 gallons per minute.

The masonry progressed rapidly, and was soon brought above the water level. No settlement took place until between the 17th and 24th September, when it was found that the pier had settled slightly. On the 2nd of October, building was suspended, the top of the structure being then 6 feet from the required height. The pier was then loaded with stone and iron, weighing about 500 tons, and it was found, on the 7th November, that a further settlement had taken place, of 0.17 feet. On the 27th January, the total settlement had reached 0.46 feet. Since the latter date no further subsidence has been detected. The load remained on the pier all winter, building was resumed on the 1st June, and in four days the structure was completed. As in pier X, the masonry settled with the mass of concrete on which it rested without loosening a joint or fracturing a single stone.

Pier C.

The depth to the bed of river at the site of this pier was 29 feet. The caisson for the foundation was similar to those already described. It was launched on the 16th of May, 1873, floated away, and finished to the height of 30 feet. On the 23d of June, it was placed in position and loaded down. The sheet piling, driven to the depth of 44 feet below high water, was completed on the 8th of July.

The dredging commenced on the 15th of August. The material overlying the gravel bed, consisted altogether of 13 feet of clean coarse sand. The dredging extended over seventeen days, but the machinery ran only nine days in all. The quantity of sand removed was 800

cubic yards, every cubic yard of water thrown out carrying with it 0.28 cubic feet of sand, or 1 cubic yard of solid matter in 94.5 cubic yards of water pumped.

The filling of the space dredged out was treated differently from that of piers X and D. Instead of the alternate layers of concrete and rubble stone, the whole space up to the level of the river bed was filled in with stone, crushed to the size used for concrete, but without sand being added; and a layer of concrete 13 feet in depth was deposited upon this base. The concrete was completed by the 29th of October, 1873, when the works were closed for the season.

On the 16th of June, 1874, everything being ready, three pumps driven by two engines, were started, with a favorable tide. The water in the dam was then run down to 12 feet below high water, but the pumps in operation could do no more. It was apparent that more power must be used. On the 22nd, a trial was made with four pumps, driven by three engines; and, for a short time, they succeeded in lowering the water to 14 feet below high water. It was necessary, however, for the four pumps to run without intermission to hold their own. On the stoppage of a pump, the water at once began to rise. A third effort was made on the following morning with the same result. The greatest head obtained was 8 feet 10 inches. On the stoppage of all the pumps, the water rose in the dam 52 inches in eleven minutes. Operations were now suspended at this pier for three weeks. It was simply a question of pumping power, and it was accordingly determined to add a large Gwynne dredge pump, and a fourth engine. In the mean time blocks of stone for a 2½ feet course were placed roughly in position by divers. The five pumps were put in operation. They succeeded in lowering and holding the water 14 feet below high water level.

On the stones being laid bare they presented an uneven appearance, some having been carried upon the *laitense*, and others upon points of concrete standing above the surface. It was accordingly necessary to raise the stones in order to obtain a level bed. By the

27th of July the first course, 2½ feet thick, was set, after which no difficulty with the water was experienced.

The Masonry steadily progressed, and no settling was discovered until the 7th of August. On the 15th, when there had been 13½ feet of masonry built, a subsidence of 2 inches had taken place. Up to the 17th of September when building was suspended at 6 feet from the full height, the total settlement was 0.24 feet. As in the other cases the pier was loaded by placing on it 575 tons over and above the weight of pier when finished. During the operation of loading, a settlement of 0.13 feet at the up-river end, and 0.07 feet at the down river end took place, and from the 23rd of November to the 31st of December 1874, a still further settlement 0.07 at the up river end, 0.09 feet at the down river end was observed. At this date the total settlement was 0.48 feet. The load remained on the pier until the 6th of April 1875, when work was resumed and completed. But no change whatever has taken place since the close of 1874; and the masonry as in the other piers remains without a flaw.

PIER B.

The depth of water was 27 feet 4 inches, and the material a clean sharp sand 24 feet 5 inches deep; the gravel bed being reached at 51 feet 9 inches below high water; a thickness of gravel 5 feet 6 inches overlying the deep deposit of silt between it and the rock.

The caisson was floated into its exact position on the 8th of July 1873. In grounding it indicated unevenness of bottom. The inequalities were rectified by the use of a force pump and hose. The piling, 50 feet long, was at once begun.

The dredging commenced on the 15th of September, and extended over 36 days. The actual running time of the two pumps was 16¼ days. The quantity of material removed from within the limits of the foundation was 1495 cubic yards. Each cubic yard of water thrown

out by the pumps must therefore have carried with it 0.29 feet of sand, or 1 cubic yard of sand with 92.7 cubic yards of water.

The dredging was completed on the 22nd of October, and the foundation was then filled with crushed stones to the level of the river bed. On the 10th of November, work ceased; at which time the filling was completed.

On the 27th of May, 1874, work was resumed. The concrete filling was completed on the 12th of June, bringing the surface up to 16 feet below high water. During the period allowed for the concrete to harden, divers were engaged putting in iron tie-rods similar to those already referred to.

An attempt was made to pump out the dam on the 13th of October, with the hope that the footings of the masonry might be laid before the season closed. Four engines with five pumps, however, after repeated attempts, failed to lower the water to the full depth required.

During the winter it was determined to add another layer of concrete 4 feet in thickness and thus bring the surface to 12 feet below high water, as at pier X. The concrete was finished on the 22d of May, 1875.

On the 13th of June, the pumps were started and the surface of the concrete laid bare in 20 minutes. The concrete was found hard and compact. The surface was levelled off, and the masonry began on the following day. It continued without interruption till the 24th of July, when work was suspended preparatory to loading the structure to test for settlement. The load in this case was 550 tons. During the process of loading, from the 24th of July to the 4th of August, the pier had settled 0.18 feet. On the 9th of August, a further settlement had taken place of 0.14 feet. On the 20th of August no further change could be observed. Building was resumed on the 24th and completed on the 30th of August.

Pier A.

The depth of water at high tide is 31 feet 6 inches at the site of this pier. The material under the river bed was a black vegetable deposit 18 feet 9 inches deep, overlying the gravel bed found at 48 feet 6 inches below high water.

The caisson was made fast in position on the 4th of September, 1873. The dredge pumps were put in operation on the 25th of Oct. and continued until the 15th November when the work was suspended for the season.

Work was resumed on the 29th of May, 1874, and the dredging completed on the 30th of June. This work extended altogether over 54 days, but the actual running time was 24 days. There were 1044 cubic yards of material removed, giving 0.14 cubic feet thrown out with each cubic yard of water, or 1 cubic yard of solid matter with 193 cubic yards of water. The space dredged out was filled in with crushed stone to the level of the bed of the river.

Early in July the concrete was begun, and deposited to a depth of 15 feet 6 inches below extreme high water. No attempt was made to pump out the foundation of this pier, as it was anticipated the same difficulties would be experienced as at pier B, and it was allowed to stand over to the following summer. During the winter it was decided to put in another 4 feet layer of concrete. This work was done early in the summer of 1875, and on the first attempt to pump out the dam the surface of the concrete was laid bare with comparatively little trouble. The water was lowered to 12 feet in 15 minutes and readily maintained there during half tide. Building was commenced on the 27th of July, and finished for the purpose of applying the load by the 21st of August. The first settlement observed was on the 4th of August, when it was found to be 0.05 feet. On the 21st of August previous to loading for test, the structure had settled 0.42 feet. The load applied was 550 tons. During the process of loading the structure settled 0.33 feet.

PLATE NO. 33.

Photo-Lith. by the Burland-Desbarats Lith. Co.

NORTH-WEST BRIDGE—RIVER MIRAMICHI.

(View of works in progress.)

The load remained for ten days without further settlement. The masonry was completed on the 14th of September 1875. The total settlement was 0.74 feet.

CONCRETE.

The concrete used in the foundations was made from broken stone, coarse river-sand, and the celebrated English Portland cement. The stone was broken to pass through a ring less than three inches in diameter. As the breaking of the stone by a Blake Machine, pulverized much of the material, the proportion of sand depended upon the condition of the stone; but sufficient sand was always added to the broken stone to fill up all the interstices and render the mass compact.

The concrete for the foundations of the Northwest Bridge was made with two barrels of cement to the cubic yard of crushed stone, that for the foundation of the Southwest Bridge with one barrel to the cubic yard; except in the filling of the caisson for Pier E, and or the wells of all the other caissons, the concrete for which had two barrels per cubic yard of broken stone. Care was taken to thoroughly mix the ingredients. The total quantity of cement used in these bridges was about 14,000 barrels.

MASONRY.

The masoury of the abutments and piers was of a thoroughly massive and substantial character. The stones were of large dimensions, well proportioned and put together in the best style ot workmanship.

Each stone in the cutwaters and exposed angles was secured by iron dowels run in with cement. The masonry was laid in Portland cement mixed in the proportion of two measures of sand to one of pure cement.

The stones for the girder seats and faces of the ice breakers

were massive blocks of granite; some of which were brought from the Nipissiguit River near Bathurst, a distance of about 175 miles by water.

The greater portion, however, was obtained from boulders near the river banks, from twelve to sixteen miles above the railway crossing. The building stone proper is a light coloured free-stone obtained from two quarries; one on the River Miramichi, about four miles below the site of the bridges; the other, from which the greater quantity was brought, near the mouth of the River Bartibogue, a tributary of the Miramichi, about seventeen miles distant from the railway crossing. Both quarries furnished stones similar in colour and quality.

The remaining work at this bridge was now confined to the deposit of rip-rap around the piers and the erection of the iron superstructure.

The plant employed in the construction of these bridges was large and costly; besides a full assortment of ordinary tools and appliances, it consisted of a steam tug, with 21 large scows; machinery worked by steam for excavating, crushing stone, pile-driving, dredging, lifting and moving material; also diving apparatus. The pumping machinery was especially effective; it consisted of 4 Woodford pumps, with 7½ inch discharge pipes, and 1 Gwynne pump with a 12 inch discharge. These were driven by 5 steam engines, of 50-horse power each. The pumps made, on an average, 400 revolutions per minute, at which rate they threw from 1200 to 1500 gallons per minute each. The Gwynne pump threw as much as 2500 gallons per minute. The Woodford pumps had their pipes in lengths of 9 feet, attached to light angle-iron frames 3 feet square; each length having its own driving shaft attached. The lengths were easily fitted into each other, and secured by small bolts at the angles, the shafting at the same time locking together. The driving pulley was quickly raised or lowered on the shafting to suit the situation, and was secured with screws. The pumps rested on the material to be removed, and although secured to the caisson so as to prevent lateral motion, they were free to move vertically and they settled down with their own weight as the material was thrown out.

In conjunction with the Woodford pumps, two powerful Cameron

PLATE NO. 34.

Photo-Lith. by the Burland-Desbarats Lith. Co.

PIER—NORTH-WEST BRIDGE—RIVER MIRAMICHI.

force pumps, with a supply of three-inch hose, capable of throwing six heavy streams, were constantly in operation. The flexible hose terminated in metallic nozzles of one-inch bore, which were attached to the ends of long guide poles, by means of which powerful jets of water were directed against the material in the coffer-dams, to loosen it, and bring it within the operation of the pumps.

The work of both bridges has been satisfactorily completed by the Contractors, Messrs. Brown, Brooks, and Ryan.

The difficulties experienced in carrying out the north-west bridge have been fully described. Mr. Joseph Tomlinson acted as Superintendent in connection with the foundations of the south-west bridge. This structure was carried to completion without any departure from the original designs, and without any claims for extras on the part of the contractors.

Mr. A. L. Light was Engineer of the District; and under him, Mr. W. B. Smellie had direct charge, as Resident Engineer, of both the Miramichi bridges, from the commencement of construction until their final completion.

The south-west bridge was first completed. The first train was passed over, and the bridge was opened for use, on August 26th, 1875, by His Excellency, General Sir William O'Grady Haly, Administrator of the Government.

CHAPTER XII.

THE NOVA SCOTIA DISTRICT.

Length and Sub-Divisions—General Description—The Cobequid Mountains—Geological Features—Springhill Coal Field—The Iron Mines—Division U, Old Line—Division V, Eastern Extension—Division W, Contract No. 11—Division X, Contract No. 4—Division Y, Contract No. 7—Division Z, Contract No. 12.

This District commences at Moncton, and after following 8 miles of the railway between St. John and Shediac, takes an indirect course, the general bearing of which is nearly south-easterly, to terminate at Truro at the head of Cobequid Bay, in the Bay of Fundy.

It comprises the following divisions :—

Division	U.	E. & N. A. Railway,	7¾	miles	long.
"	V.	Eastern Extension,	37	"	"
"	W.	Contract No. 11, - -	4½	"	"
"	X.	" " 4, - -	27	"	"
"	Y.	" " 7, - -	24¼	"	"
"	Z.	" " 12, - -	24¼	"	"
		Total length, - -	124¾	miles.	

It has the most crooked alignment, the greatest extent of curvature, the sharpest curves, the highest bridge, the deepest embankment, the steepest grade, and the second highest summit on the whole railway. It touches tide water at four points, and a considerable summit is found between each two of the points. It has the longest stretches of the most level ground; and it passes through the roughest country, except that at the chief summit on the St. Lawrence District. The character of its soil is accordingly varied, ranging from the highest fertility in the marshes surrounding the heads of bays of

the Bay of Fundy, to almost absolute barrenness in the elevated spots. Its rocks range from the granite of the Cobequid mountains, to the coal measures. It was the source of protracted contention in regard to the route; although the location was confined to the narrow limits of an Isthmus between the Gulf of St. Lawrence and the Bay of Fundy.

The Cobequid mountains cross the Nova Scotia District about 25 miles from its southerly end. From Moncton to the Cobequid range, the line crosses three belts of lower carboniferous rocks, and two of the middle coal formation; one of the former being at either extremity, the third being in the middle. The well-known Springhill coal field, is situated on the most southerly of the belts of the middle coal formation.

The flanks of the Cobequids are occupied by rocks partially metamorphosed. On the southerly side the strata consist of quartzites and slates. These are intersected by a large irregular vein composed of carbonates and oxides of iron. This vein extends a long distance on each side of the railway, and is being worked by the Steel Company ot Canada. The construction of the Intercolonial line and the Branch to Pictou, places the iron region midway and within easy reach of two all but inexhaustible coal fields. These favourable conditions promise the future establishment of important industries in this quarter.

In the middle of the Cobequid range, a hard reddish granite or gneiss is met. Between the Cobequids and Truro, the railway traverses another trough of carboniferous rocks, but no coal-seams sufficiently thick for profitable working, have been found.

The first District Engineer, was Mr. W. H. Tremaine, who had had the conduct of the location surveys, and also assisted in the preliminary surveys of 1864. He remained in charge of the works until the close of 1871, when he was succeeded by Mr. Collingwood Schreiber, who remained until their completion.

DIVISION U.

This title has been given to a section, about eight miles long, of the St. John and Shediac Railway, extending northward from Moncton to Painsec, which is common to the two railways. The St. John and Shediac Railway was constructed by the Government of New Brunswick, and is a part of one of the rival schemes of 1845, for connecting Quebec and Halifax. This section was opened for public traffic in 1860, and having been well constructed is in excellent order. The Engineer-in-Chief, was Mr. A. L. Light.

DIVISION V.

This Section, otherwise known as the "Eastern Extension" of the St. John and Shediac Railway, extends from Painsec to the Provincial Boundary Line.

It was constructed by a Company under contract with New Brunswick, and was finished during the summer of 1871. After completion it was purchased for the Government of the Dominion, by the Intercolonial Railway Commissioners, for the sum of $894,000; being at the rate of $24,000 per mile, for 37¼ miles, its total length. The line departs, to some extent, from a right line drawn between the termini; making a sweep of seven miles in a distance of 20 miles. Besides this general deviation, the line in itself is exceedingly crooked, 13 of the 37 miles being on curves, some of which are very sharp. About the middle of the division there is a sharp 4° curve (Radius 1432 feet) which sweeps round a semicircle; it is succeeded by another curve, nearly as sharp, which passes round three-eighths of a circle. These curves are on long maximum grades.

As a great deal of this division is on meadow land, the cuttings and embankments are generally light. There is, however, some heavy work,

but as the railway was constructed at a fixed rate per mile, easy construction was more attended to than directness of route. Consequently, even in the most difficult sections of the route, so much curvature has been thrown into the line, that the earthwork on the whole, is comparatively easy. The curves are, as a rule, sharp, and the grades steep.

From Dorchester, the middle of the division, for more than four miles, there is an almost continuous ascending grade, the greatest part of which rises 1 in 100. It is succeeded by a continuous descending grade of 1 in 100, for 2 miles. The remaining grades are easy, the few that rise quickly, have been introduced to reduce the earthwork.

In the meadow lands, or marshes, which would be covered by high tide, "aboideaus" have been built across the embankments to keep back the rising tides. They are square wooden culverts, generally about 3 feet 6 inches wide, each side made of three squared logs, laid transversely to the railway, the top and bottom being of squared logs laid at right angles with the sides. The lower end for six or eight feet, is 4 feet 4 inches square; where the narrow dimensions commence, two half doors are hung horizontally, one at the top and one at the bottom, closing together tightly in the middle, the lower rising with the rising tide. They are made of hard wood, in pieces bound together by copper bolts. The lower falls on a slip of wood to keep up the outer edge a few inches, and the rush of the incoming tide is sufficient to raise it to a vertical position and close it. Under circumstances where a larger sectional area is necessary for the drainage discharge, instead of increasing the size of the aboideau, two or more are constructed side by side. In one case, at Aulac, east of Sackville, there are five. These aboideaux have in all cases been found very efficient.

When the railway embankments are subject to the action of the tides, a cheap but efficient protection for the slopes, has been formed, by placing trees and brushwood in layers at right angles to each other, with thin *couches* of ordinary marsh mud* between them. This protection, even when almost plumb on the face, has fully succeeded.

* The local term for the rich plastic substance thrown up by the tides of the Bay of Fundy.

On this portion of the Railway there are many small pile and trestle bridges. A peculiarity in their construction is the use made of "Ships' Knees" as angle pieces.

A bridge with three spans, each 160 feet wide, crosses the river Tantramar, at Sackville. The superstructure is of iron, on the English lattice principle: the roadway is on the lower chord, the upper horizontal bracing being at a height to admit the passage of trains. The piers were, in the first place, of slight construction. Indeed they may be described as having had no greater dimensions than was barely necessary to carry the superstructure. Consequently, the first winter tried them severely; one pier subjected to a heavy thrust of ice was found not to have strength sufficient fully to resist the strain, and a displacement resulted endangering the whole structure. These piers have since been rebuilt, at a cost many times exceeding the outlay which would have been necessary to build them sufficiently massive in the first place.

Six miles from Painsec, there is an iron girder bridge of 50 feet span; the only one of the Warren pattern between Rivière du Loup and Halifax. The roadway is carried on the top chord.

In general, there is not sufficient ballast on this division, and in many places it is not of good quality. Difficulty was experienced in obtaining suitable material; excepting near Sackville, there was no good gravel to be had on the line. Iron rails are laid 34 miles; the rails have not worn well; the insufficiency and inferior quality of the ballast have doubtless contributed to this result, for without good and sufficient ballast no road can be maintained in good order.

The Eastern Extension, having been constructed by the Province of New Brunswick, ends at the boundary between that Province and Nova Scotia, in the middle of the river Missiguash; and, as is usual in such cases, only the Western abutment of the bridge over that river was built by New Brunswick.

PLATE NO. 35.

Photo-Lith. by the Burland-Desbarats Lith. Co.

SACKVILLE BRIDGE.

DIVISION W.

Contract No. 11.

This Division begins in the middle of the river Missiguash, and includes the Eastern abutment and the whole superstructure of the bridge.

This superstructure is of wood, a Howe truss, with the roadway on the bottom chord. The span is 100 feet, the width between the trusses 19 feet, and the total height of the truss to the upper horizontal bracing, 21 feet 6 inches. It is the third of the wooden truss bridges on the whole line of the Intercolonial Railway.

Although timber has been employed in spanning the river, the abutments are of substantial masonry, in every way suitable for the support of iron girders; should a spark at any time from passing trains lead to the destruction of the bridge by fire, and for a time sever railway connection between the two Provinces.

The masonry is built on a pile foundation properly protected by crib-work and rip-rap from the wash of the tide.

There are two aboideaux on this division; one for Gordon's Brook, near the first mile; and the other for the river La Planche, about 2½ miles from the beginning of the division. The first has double, and the second has four-sluiced passages.

There was considerable sinking of embankments over places where the marshes were soft and boggy, but it was anticipated and provided for.

The division is only 4½ miles long. The work was let in November, 1869, to Messrs. Davis, Grant and Sutherland, for $61,713, to be completed by September of the year following. Changes were made in the location and grades, by which the cost of construction was increased by $8,668.24. The work was not finished until 27th November, 1871.

The average quantity of excavation is 37,750 cubic yards per mile, and of masonry 290 cubic yards.

The Resident Engineer in charge was Mr. George H. Henshaw.

DIVISION X.

CONTRACT No. 4.

This Division, 27 miles long, is the longest division constructed under the Commissioners. It begins one mile east of Amherst, on the "Amherst Ridge," where there is a cutting, one mile long, which contained 60,000 cubic yards. The embankment following was calculated to require 50,000 cubic yards in less than half a mile of its length. On account of its soft marshy bottom, a further quantity of 18,000 cubic yards was provided. The embankment has settled down, spread out at the base, and raised up the adjoining surface; the sinkage still continues, and the embankment requires occasional attention. There is, however, no probability of accident.

The line is much curved, there being forty curves amounting in the aggregate to nearly 13 miles in length, with more than 1600 degrees of curvature. One curve, almost a mile long, encloses an arc of 127 degrees; and is followed by one, 1000 yards long, enclosing an arc of 103 degrees. Only a few of the curves are of short radius.

Generally the grades are approximately level. But for 14 miles the separate grades vary from 0.75 in 100 to 1 in 100, three ascending eastwards, divided by level, or easy grades in the same direction; the total height ascended is 206 feet in 5 miles, gaining the highest point on the division, 245 feet above the lowest point. The line then descends continuously for 133 feet in a length of 3½ miles.

The first cutting, with 60,000 cubic yards, is the heaviest on the division. The cutting at the tenth mile contained 42,000 cubic yards. There are four heavy embankments, the lightest requiring 42,000 cubic

PLATE NO. 36.

Photo-Lith. by the Burland-Desbarats Lith. Co.

MISSIQUASH BRIDGE

(One of the three wooden bridges on the Railway.)

yards, the heaviest 65,000 cubic yards. Except on the marshes the embankments are all short; the cuttings are also short.

The quantity of rock in the cuttings, was in the ratio of one to twenty of earth.

A special protection, which has been found efficient, was provided for the railway, where the line runs close to the Maccan river. Piles were closely driven to the level of the ground, by the side of the river, stayed by a second row of piles driven inland, 10 feet apart, the space between being filled with stone and brushwood.

There are several aboideaux on the line, similar to those described, and many small culverts of masonry.

The Nappan river is crossed by a bridge 100 feet wide, with wrought iron superstructure, having the roadway on the lower chord. The abutments are built on a pile foundation, the outside piles being closely driven, and the foundations protected by masses of heavy riprap. Embankments washed by the tide are protected, according to local practice, by brushwood and small poles, laid in layers with "marsh mud" between them.

A skew bridge of 24 feet span, with iron superstructure, is constructed over a tramway from a coal mine.

A third bridge, of 100 feet span, with iron superstructure, is built over the Little Forks river. The abutments are about 33 feet high, built on rock a few feet below the bed of the stream.

The work was let in 1869, to Messrs. Elliott, Grant and Whitehead, for the sum of $297,000. At the close of that year, when work to the amount of $46,200 had been performed, the contractors found their prices were too low; and their contract was annulled. On 25th May, 1870, a new contract was entered into with Messrs. Smith and Pitblado, to finish the work for $438,326, on 1st July, 1871. It was finished one year later.

The length of the division is 27 miles. The average quantity of excavation per mile is 25,800 cubic yards, and of masonry 418 cubic yards.

The Resident Engineer to the close of 1871, was Mr. Geo. H. Henshaw: at the latter date the District Engineer assumed charge and Mr. J. R. Smith acted as assistant.

At the Springhill station, a branch has been constructed to the Springhill coal mines. It is short, with sharp curves and steep grades, and with numerous changes in both. The ballast is bad, in many places being sandy clay. The Branch is not a part of the Intercolonial Railway, but is worked by the Springhill Coal Company.

DIVISION Y.

CONTRACT No. 7.

This Section is heavy, having upwards of a million cubic yards of earth excavation, and forty thousand cubic yards of rock. Nearly all the heavy work is on the last six miles. There are several deep rocky ravines, the embankments over three of which have respectively a height on the centre line of 70 feet, 96 feet, and 105 feet. One cutting, chiefly rock, has a depth of 52 feet on the centre line; as these works are on the steep sides of hills, so the extreme heights and depths are greater.

The division for three-fourths of its length is on ordinary rolling land; but for the remaining distance it lies on steep rocky side-hill, by which it ascends from the valley of the river Wallace, to a high summit at Folly Lake, the highest point on the railway between Metapedia and Halifax. The height of this summit is 607 feet above the sea, and the height of the lowest point, at River Philip, near the west end of the division, is 83 feet, so that the total ascent is 524 feet. On the whole length there are eleven miles of steep grades varying from 0.80 in 100 to 1 in 100, 1½ miles descending, and 9½ miles ascending, towards Truro.

PLATE NO. 37.

Photo-Lith. by the Burland-Desbarats Lith. Co.

RIVER PHILLIP BRIDGE.

The curves are numerous and some are sharp; one, a 4° curve, 1433 feet radius, is nearly 2100 feet long; and another, a 3° 20′ curve, radius 1619 feet, is over 1800 feet long. The total length of curves is above 10 miles, and the total curvature amounts to 1025°. The tangents are all short except in one instance, where the length is 5 miles.

On this division seven tunnels are introduced, in place of long heavy culverts, in the ravines passed over; three of 9 feet diameter, four of 7 feet. The three former are respectively 300, 355, and 370 feet long. These seven tunnels are cut through solid rock; and require no lining, except in the case of one, which, for a length of 211 feet in the middle, required the protection of stone masonry 18 inches thick, with a water-way of 6 feet. There are, moreover, several tunnels 4 feet wide by 5 feet high, to take the place of box culverts for ordinary surface drainage. These tunnels are constructed on a steep side-hill and answer the purpose well. The small tunnels, at the upper end, have a wide perpendicular well, cut into the rock, from the bottom of which the incline commences, parallel to side-hill. Choking by floods and injury to the road-bed are thus avoided. A depth of at least 6 feet of solid rock has been maintained over the smaller, and of 12 feet over the larger passages so the conduits themselves are imperishable.

There are three bridges on the division, one over the river Philip with three spans each 100 feet wide. The two others have spans of 50 feet and 60 feet, over branches of the Wallace river. There is nothing peculiar in their construction. The extreme height of the bridge over the river Philip is 60 feet.

The work was let in 1869 to Messrs. H. J. Sutton & Co., for $413,955. After executing work to the extent of $53,731, in 1869, the contractors gave up their contract, as their prices were too low. The remainder of their work was let in May, 1870, for $557,750, to Messrs. James Simpson & Co., the work to be completed on 1st July, 1871; but it was not completed until the summer of 1872.

The total length of the division is 24¼ miles. The average quantity

of excavation is about 45,260 cubic yards, and of masonry 342 cubic yards, per mile. There are besides 576 lineal feet of cast iron pipe culverts, and 1803 lineal feet of tunnels.

The Resident Engineer from the commencement of the work until the close of 1871 was Mr. Tom S. Rubidge, who had been employed in the Exploratory surveys of 1864. Mr. P. S. Archibald, his assistant remained until the rails were laid, and had charge of the track laying and ballasting.

DIVISION Z.

Contract No. 12.

The first seven miles of this division have many curves, the line winding round headlands of the River Folly valley; the remainder of the division has long tangents with some long flat curves.

As the Railway falls from Folly Lake, 600 feet above the level of the sea, to Truro, only a few feet above the sea level, many of the grades are extreme, the greatest difference of level being 578 feet. One continuous grade, more than two miles long, descends at the rate of 1.20 in 100. There is an aggregate length of 5½ miles on grades descending at rates varying between 0.80 and 0.94 in 100. There are in all 10½ miles of heavy grades on the Section.

Several tunnels take the place of culverts under deep embankments; with one exception, in compact conglomerate rock, all required to be lined, the other six being built in soft red sandstone, or rather a hardened sandy clay.

The most important of the several iron bridges, is that over the river Folly, with six spans of 100 feet, 82 feet in height from the bed of the river, a striking structure built of durable sandstone of various colours. The foundations are on rock. It spans the eastern portion

PLATE NO. 38.

Photo-Lith. by the Burland-Desbarats Lith. Co.

VIADUCT ACROSS FOLLY VALLEY.

of the valley at this place. A long narrow ridge, about 50 feet high, divides the valley of the Folly from that of a smaller stream. This second valley, 80 feet deep, is crossed by a solid embankment; the stream being diverted through a tunnel into the Folly.

There are three low bridges, each with two spans of 100 feet; another bridge, over the Salmon river at Truro, has three spans of 100 feet.

The work was let by contract in 1869, to Messrs. Sumner and Somers, for $597,600, to be completed on 1st July, 1871. But on July 1st, 1872, although $551,000 had been paid to the contractors, the work being much behindhand, the Government undertook its completion by days' labour. $105,000 in excess of the original contract sum has been expended.

The total length of the division is 24½ miles; the average quantity of excavation about 43,700 cubic yards per mile, and of masonry 462 cubic yards. There are 1251 lineal feet of tunnels.

The Resident Engineer was Mr. Wm. Hazen, who had been on the location surveys of 1869. He was in charge until the close of 1871, after which the District Engineer took charge.

At Londonderry station, about 7 miles from the commencement of the division, a branch 3 miles in length, runs to the Londonderry Iron mines. It was constructed by the Mining Company.

At Truro, the Railway joins the line constructed from Halifax to Pictou by the Government of Nova Scotia, before the union of the Provinces.

CHAPTER XIII.

Concluding Remarks.

Scope of the Volume—General Statements—Opening of Sections—Gross Quantities of Work—Average Quantities per Mile—Total Expenditure—Review of the Boundary Question—Diplomacy of the United States—Sacrifice of British Interests—The Lesson Taught—General Observations—The Railway and the Dominion—Historical Events—Suggestive Associations—Men identified with the Railway—A Coincidence—Opening of the Line

It has been the aim of the writer to give, in the preceding pages, a concise account of the Intercolonial Railway, in its several stages. While setting forth the principal facts in its history, as far as he has been able, the writer has also presented those subsidiary events, which have more or less influenced the project from the beginning. These records may appear of doubtful utility to those who are familiar with them; but, when the present actors shall have passed away, the permanence of the record may be held by another generation to be of some value.

The Railway will hereafter be known to the general public chiefly on account of the advantages which it has created, and the conveniences which it has increased. To the statesman and the engineer, its history has more suggestive teaching. The writer, however, does not conceive it to be his province to enlarge on this view. It only remains for him to add some general statements respecting the undertaking, and so bring to an end the duty he has assumed, of recording its vicissitudes and its successful consummation.

The line south of Moncton has been open since 1873, by which means Railway connection between St. John and Halifax was attained. At the north the distance from River du Loup to St.

Flavie, 86 miles, was opened in August, 1874. Between Campbelton and Moncton, 185 miles, trains have been running, with some interruptions, since last winter. The remaining sections are now completed, and the line may be considered fit for traffic throughout.

Tables are given, in the appendix, which show the gross quantities of the work in each District, and the average quantities per mile on each Division. Being based on the returns of actual measurements, they may be regarded as authoritative.

They show that more than two hundred thousand cubic yards of masonry has been built, and that the excavation amounts to sixteen million cubic yards, of which nine to ten per cent has been rock.

Comparing the different Divisions, the lowest average excavation per mile is 13,665, the highest 81,996 cubic yards. The lowest average of masonry is 179, the highest is 2,004 cubic yards per mile.

Making comparison of the four Districts, the average excavation per mile is as follows: —

The St. Lawrence District	33,631	cubic	yards.
The Restigouche District	33,000	"	"
The Miramichi District	31,940	"	"
The Nova Scotia District	30,200	"	"

The average masonry per mile may also be stated thus: —

The St. Lawrence District	332	cubic	yards.
The Restigouche District	557	"	"
The Miramichi District	376	"	"
The Nova Scotia District	330	"	"

On the line, as a whole, the average gives the excavation at 32,210 cubic yards, and the masonry at 401 cubic yards per mile.

It is not practicable to state the precise cost of the several sections in each case, as many of the claims advanced by contractors are unsettled. Moreover, some time must elapse before the entire ballasting and draining are thoroughly completed.

At this date, the capital account shows a total expenditure of $21,569,136.79, on all services, including branch lines and rolling-stock.

The statements of quantities and cost may be said to be all that was needed to close the description of a work which, for so many years, has occupied public attention, and which is now a fact in the history of the Dominion.

The Boundary question, no pleasant page in our records, might have been briefly passed over: the consideration of it adds little to national pride, or national satisfaction. But when we find that railway connection with the nearest British Atlantic port is now attained by traversing twice the distance which, under a just settlement of that question, would have been necessary, the subject prominently presents itself; and the events which led to this condition of affairs claim investigation that could not be avoided.

At this date, we look back with bewilderment at the extraordinary series of negotiations which ended in the establishment of the Maine Boundary, — a result which converted undoubted British territory into foreign soil, which alienated the allegiance of thousands of British subjects, without their consent, and which made a direct connection on our own soil, between Central Canada and the Atlantic, an impossibility.

The diplomacy of the United States has not always appeared so straightforward as it seems to have been in this matter. Individual citizens may have acted in a captious, exacting and aggressive spirit. But it is evident, throughout, that the Executive at Washington desired to settle the line of boundary, described in the Treaty of 1783, on a fair and equitable basis. Indeed, it is scarcely possible to suggest a proposal more marked by sagacity and justice than that made by President Jackson. The local irritation in Maine was a minor quantity in the problem; General Jackson would have eliminated it in a very simple manner. The truculence of a few provincial politicians would have cost him little thought. In Lord Ashburton's

time the temper of individual citizens would have been as readily controlled by Daniel Webster, whose strength of will would have been little coerced by the now forgotten delegates sent to assist him.

The local irritation in Maine did not gain strength until years after the rejection of the Washington propositions for a settlement. The ill-feeling subsequently shown was strongly incited by the men who sympathized with the Canadian rebellion of 1837. Had the offers made by the United States been accepted, the boundary would have been satisfactorily established long before the period of the outbreak. Even in 1842, it was possible to fall back upon President Jackson's offer, had Lord Ashburton possessed the least fitness for his duties.

No Canadian can reflect, without pain and humiliation, on the sacrifice of British interests in the settlement that was made. Yet however strongly we may be actuated by this thought, we can have no ill-feeling against the United States. The fault does not lie with the Washington Government. It is due to the ignorance of the merits of the case, and to an indifference to the interests at stake, on the part of the Imperial representative, who had been entrusted with the protection of the rights and the honour of the Empire.

The Imperial authorities recognize the lesson taught by the Ashburton Treaty, in adopting the policy of the federation of the British American Provinces, and in acting on the principle that no Canadian interest shall hereafter be discussed in Imperial negotiations without the presence of a Dominion representative.

It is scarcely necessary to say that these remarks in no way point to a severing of the tie that links Canadians to the Parent Land. The universal feeling throughout the Dominion is, that British connection is a mainstay in our political existence; and the strength of that connection has been shown by the way in which it has withstood occasional shocks, among which may be reckoned the Treaty of 1842. Though the Dominion has sustained an irreparable loss of inheritance, she fully appreciates the advantages of her position. Under the

fostering care of the Mother Country, she has passed peacefully into the possession of illimitable acres, vast forests, inexhaustible deposits of mineral wealth, and fisheries on three oceans. Her still boundless territory and resources will tax the energies and enterprise of her sons for centuries, and may well afford room and welcome for the millions who may seek her shores from less favoured lands.

For more than twenty years after the Ashburton Treaty, many fruitless attempts were made to revive the railway project. Delegation after delegation called upon the Home Government, without success, to connect the several Provinces by railway, so that British America should have the means of inter-communication. Explorations and surveys were indeed made, but no practical result followed until the time arrived for the political union of the Provinces.

The Intercolonial Railway owes its existence to the creation of the Dominion, although it may be said that neither could have been consummated without the other. One of the first efforts of united British America has been the establishment of this line of communication, to make intercourse possible between the Provinces. It is the railway which brings the Maritime Provinces into connection with Central Canada. At each extremity of the wilderness hitherto unoccupied except by the hunter or the Indian, and never traversed without difficulty, were found separate communities, each with the sentiment that all had interests in common; all equally belonged to the outer Empire of Great Britain; all were identified with her glories and greatness; all had been devoted to her in the hour of trial, yet all were denied means of intercommunication, and were unable to unite for a common purpose. There is no longer an unpenetrated wilderness to bar the hope of realizing all the benefits of union. The Provinces are now brought into daily connection and association, possessing identity of political life, with institutions extending equal justice to all, covered with the ample flag of the Empire, and with advantages which are unrivalled. If we but prove true to ourselves, our future prosperity is assured.

It does not fall within the province of the writer to allude to the past history of the country, or to make special mention of the places of interest that are reached by the Railway. The district now opened up has, through want of communication, been hitherto cut off from the every-day life of the rest of Canada; but it possesses much to repay the tourist, both in the variety and character of its landscape and in the traditions which throw a halo over many a locality.

The railway will give easy access to many of the scenes of the long struggle between France and Britain for the mastery of the Northern Continent, terminated by the triumph of Wolfe at Quebec. The record of many of these events is still imperfectly written. The naval engagement on the Bay Chaleur, the fierce contests around the now grass-grown Forts of Lawrence, Beausejour and Moncton, are seldom heard of; but the scenes of these conflicts are now made accessible; and some future historian, may, by the inspiration of viewing the ground, be induced to perpetuate the events. The expulsion of the Acadians from their homes, which, Wolfe declared, "added nothing to the renown of the King's arms," we may wish to forget. The ever-memorable Miramichi fire, half a century ago, still remembered, might well be entombed in similar oblivion; but the tale is to be told, and to be remembered.

More than three centuries ago, Jacques Cartier, coasting by New Brunswick, landed on its shores, to abandon them for an exploration of the great river, with which his memory is for ever connected.

At a still earlier date fishermen from the Basque Provinces left their Biscayan homes, to enrich their country by the oil and ivory of the walrus, which in vast herds frequented the Bay Chaleur and the St. Lawrence, in those early days. Pushing investigation still farther back, we meet the Indians, who held the country as a possession from nature. We ask the remnants of this once fierce and numerous race, and we ask the ethnologist, equally in vain, whence they came, and from what stock they descended. The district traversed by the

railway is full of suggestive associations, and cannot fail to awaken the attention and interest of enquiring minds.

During the past forty years many public men, conspicuous in the Councils of the several Provinces, have been identified with this railway. Of late years another class, less prominent but more numerous, have been the direct and immediate instruments in bringing the work to its present completion.

All may feel an honest pride in this connection, whatever part they played. Some may have toiled for renown: others have patiently and silently laboured for duty or for bread.

The traveller, who is borne onwards, moving in an hour a distance which would have taken weeks to traverse through the tangled forests, scarcely casts a thought on the thousands of the sons of labour, who toiled so many days and years, in making smooth his path. Prominent in the list are those who explored the forest, who traced the line, and who directed the work to its completion. Their professional brotherhood and official relationship with the writer suggests to him the duty of placing their names permanently on record. The Engineering Staff, from the earliest explorations to the present time, is given in the Appendix. It is a mournful duty more especially to record the names of those who have fallen, and to pay the last tribute to their memory.

It appears, from the account of Jacques Cartier's first voyage, that on the 1st July, 1534, at a point between the Bay Chaleur and Miramichi, he first planted his foot on the new Continent.

On the 1st July, 1761, the great Indian Chief, Argimault, whose race had long warred against the British settlers, met the authorities at Halifax, and terminated the Indian wars, by declaring perpetual submission to Great Britain, and with great solemnity buried the hatchet for ever.

The Dominion came into being 333 years after the bold navigator of St. Malo landed on the shores of Acadia; and the anniversary of its

birth in the present year marks another important epoch in the history of the country. On this day, July 1st, 1876, may be chronicled the completion of the Intercolonial Railway, and the full consummation of the union of the British Provinces in North America.

APPENDIX.

TABLE of Gross Quantities of the principal kinds of work executed on the whole line.

DESCRIPTION OF WORK.	QUANTITIES.	
Forest clearing - - - - - - - - - - - -	5,162	Acres.
Earth excavation - - - - - - - - - - -	14,546,218	Cubic yards.
Rock excavation - - - - - - - - - - - -	1,543,577	Do.
Total excavation - - - - - - - - - - - -	16,089,795	Do.
Masonry - - - - - - - - - - - - - - -	200,467	Do.
Iron pipe culverts, 2,188 lineal feet, equal to substituted Masonry - - - - - - - - - - -	8,000	Do.
Tunnels for streams, 4,862 lineal feet, equal to substituted Masonry - - - - - - - - - -	25,000	Do.
Concrete - - - - - - - - - - - - - - -	12,000	Do.
Iron Bridge superstructure - - - - - - - -	14,410	Lineal feet.
Timber Bridge superstructure - - - - - - -	830	Do.
Cross Ties (Sleepers) - - - - - - - - - -	1,250,000	
Steel Rails - - - - - - - - - - - - - -	43,500	Tons.
Iron Rails - - - - - - - - - - - - - - -	4,500	Do.

[illegible] Excavation [illegible] Masonry per mile.

[illegible]	[illegible]	[illegible]	Excavation.			Masonry
				Per centage		
			[illegible]	Rock	Earth	Cu. yds.
[illegible]	[illegible]	[illegible]	[illegible]	7	93	[illegible]
	[illegible]	[illegible]	36,140	—	100	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	320
	[illegible]	[illegible]	[illegible]	4	96	179
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	423
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]			[illegible]	11	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	6	94	435
	[illegible]	[illegible]	[illegible]	10	90	445
	[illegible]	[illegible]	[illegible]	13	87	1034
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	477
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	572
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,061
[illegible]			[illegible]	[illegible]	92	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	172
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	430
	[illegible]	[illegible]	[illegible]	3	97	2004
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	269
	[illegible]	[illegible]	[illegible]	7	93	299
	[illegible]	[illegible]	[illegible]	5	95	270
[illegible]			[illegible]	7½	92½	376
[illegible]	[illegible]	—	[illegible]	—	100	250
	[illegible]	—	[illegible]	5	95	212
	[illegible]	[illegible]	[illegible]	—	100	[illegible]
	[illegible]	[illegible]	[illegible]	7	93	418
	[illegible]	[illegible]	[illegible]	7	93	342
	[illegible]	[illegible]	[illegible]	18	82	462
[illegible]			[illegible]	10	90	330
[illegible] whole line			[illegible]2,210	9	91	401

THE SHORT OCEAN PASSAGE.

EXTRACTS FROM THE CHIEF ENGINEER'S REPORT OF 1865, ON THE EXPLORATORY SURVEY FOR THE INTERCOLONIAL RAILWAY.

"Newfoundland, a large Island off the main land of North America, and Ireland, an Island off the European coast, resemble each other in being similar outlying portions of the Continents to which they respectively belong. Possibly they may have a more important similarity and relationship, through the remarkable geographical position which they hold, the one to the other, and to the great centres of population and commerce in Europe and America.

A glance at the chart of the Atlantic will shew that between Ireland and Newfoundland, the Ocean can be spanned by the shortest line.

Ireland is separated from England and Scotland by the Irish Channel; Newfoundland is separated from New Brunswick and Nova Scotia by the Gulf of St. Lawrence. Already railways have reached the western coast of Ireland and brought it within sixteen hours of the British capital. Were it possible to introduce the Locomotive into Newfoundland and establish steam communication between it and the cities of America, a route would be created from Continent to Continent, having the Ocean Passage reduced to a minimum.

This route would not be open for traffic throughout the whole year; during certain months, the direct course of steamers would be so impeded by floating ice, that it could not with certainty or safety be traversed. It therefore remains to be seen whether the route has sufficient advantages whilst open, to recommend its establishment and use, during probably not more than seven months of the year.

In this respect the Newfoundland route must be viewed precisely in the same light as many other lines of traffic in North America, and possibly it may be found of equal importance. Of these works may be mentioned the Canals of Canada and the United States, which although closed to traffic during winter,

have justified the expenditure of enormous sums of money in their original construction, and in repeated enlargements and extensions.

Having alluded to the great objection to a route across Newfoundland, we may now proceed to enquire into its merits.

The track of steamers from the British coast to New York, and to all points north of New York, passes Ireland and Newfoundland, either to the north or to the south; the most usual course, however, is to the south of both Islands. Vessels bound westerly, make for Cape Race on the south-easterly coast of Newfoundland; whilst those bound easterly, make Cape Clear on the south-westerly angle of Ireland. Not far from Cape Race is the Harbour of St. Johns, and near Cape Clear is the Harbour of Valentia; the one is the most easterly Port of America, the other is the most westerly Port of Europe. They are distant from each other about 1640 miles.

The Irish Railways are not yet extended to Valentia, but they have reached Killarney, within about 30 miles of it.

From St. Johns across Newfoundland to the Gulf of St. Lawrence, the distance is probably about 300 miles. On the St. Lawrence coast of the Island, the Chart shews two Harbours, either of which may be found available as points of transhipment; the one St. George's Bay, the other, Port au Port; they are situated near each other, and both are equally in a direct line from St. Johns westerly to the main land.

On the westerly shore of the Gulf, we find at the entrance to the Bay Chaleur, the Harbour of Shippigan. From St. Georges Bay to Shippigan, the distance is from 240 to 250 miles. Shippigan may be connected by means of the contemplated Intercolonial Railway with Canada and the United States.

The line of Steam communication from Great Britain across Ireland and Newfoundland, and by the contemplated Intercolonial Railway to the Interior of North America, possesses some important recommendations as will presently be seen. It will, however, first be necessary to allude to the question of speed.

At the present time Ocean Steamers generally carry both freight and passengers, and in this respect they are like what are termed "mixed trains" on Railways. These mixed trains are employed to serve localities where there is not sufficient passenger and freight traffic to justify the running of separate trains.

On railways doing a large business, the traffic is properly classified; fast trains are run to carry passengers and mails only, whilst slow trains are used to

convey heavy freight. A similar classification of Ocean traffic may be suggested. Freight will naturally go by the cheapest mode of conveyance, while Passengers and Mails will seek the speediest.

It is well known that the shape of a steamship, other things being equal, governs her speed. The shape again depends on the load she may be constructed to carry: if the ship is required only for mails and passengers and such voyages as need but a small quantity of fuel, she may be constructed on a model both sharp and light, and thus be capable of running more rapidly than if built to carry heavy and bulky loads. A steamship for heavy loads may be compared to a dray horse, whilst one made specially for passengers and rapid transit, may resemble a race horse, and like the latter, the less weight carried the more speed will be made.

If these views are correct, it is clear that the speed of Ocean Steamships might be considerably increased when constructed for a special purpose. The distance between St. Johns (Newfoundland) and Valentia, is not much more than half the distance between Liverpool and New York; and hence about half the quantity of coal and supplies would be required for the passage, between the former points.

It is quite obvious, therefore, that a steamship constructed specially to run between St. Johns and Valentia, and for the purpose of carrying only passengers and mails, with such light express matter as usually goes by passenger trains, would attain a higher rate of speed than existing ocean steamers.

A rate of 16½ miles per hour is thought to be quite possible: the distance between Valentia and St. Johns is 1640 miles. At this assumed rate therefore the ocean passage might be accomplished in 100 hours.

With regard to the speed on land, it appears from Bradshaw's Railway Guide, that the Irish mails are regularly carried between London and Holyhead at the rate of 40 miles an hour including stoppages, that the Irish Channel is crossed at the rate of 16 miles an hour, including the time required for transhipment at Holyhead and Kingston, and that the mails reach Queenstown some 16 hours after they leave London. Valentia is very little further from Dublin than Queenstown, and on the completion of a railway to Valentia, there is nothing to prevent it being reached from London in the same time now occupied in carrying the mails to Queenstown.

Galway has been mentioned as a proper point to connect with ocean

steamers, it is fully an hour nearer London than Valentia, but probably three hours (in time) further from America.

Although 40 miles an hour is a common rate of speed on the railways in England, it is not usual to run so rapidly on the American side of the Atlantic. On the leading passenger routes in the United States, 30 miles an hour including stoppages is attained. With the rail track and rolling stock in a good condition, there is no difficulty in running at these rates of speed. Therefore, a minimum rate of 30 miles an hour, may reasonably be assumed as that at which the mails might be carried overland, to various points hereafter referred to.

Having fixed upon a practicable rate of speed by land and water, the time necessary for the conveyance of the Mails from London to New York, by the projected route, may now be ascertained;

From London to Valentia at present rate of speed in England . .	16	hours
" Valentia to St. Johns, 1640 miles at 16½ miles per hour .	100	"
" St. Johns to St. Georges.	8½	"
" St. Georges to Shippigan, 250 miles at 16½ miles per hour	15½	"
" Shippigan to New York, 906 miles at 30 miles per hour .	31	"
Total.	171	hours.

It is thus apparent, that without assuming rates of speed at all extraordinary, it would be possible to carry the mails from London to New York in 171 hours, or 7½ days, by the route passing over Ireland, Newfoundland, and by the proposed Intercolonial Railway from Shippigan.

In order to compare the route referred to with existing lines, the results of the past year (1864) may now be presented.

PASSAGES BETWEEN LIVERPOOL AND NEW YORK.

Name of Steamship Line.	West'n Pas.	East'n Pas.	Mean.
Inman Line.—Average of 52 Eastern and	d. h. m.	d. h. m.	d. h. m.
52 Western passages	13 19 11	12 18 54	13 [illegible] 7
Shortest passages	11 5 0	10 5 0	10 [illegible] 7
Cunard Line.—Average of 27 Eastern			
and 25 Western passages	11 12 46	10 11 42	11 0
Shortest passages	9 17 0	9 3 0	9 01

PASSAGES BETWEEN SOUTHAMPTON AND NEW YORK.

Name of Steamship Line	West'n Pas.	East'n Pas.	Mean.
Hamburg Line.—Average of 23 Western	d. h. m.	d. h. m.	d. h.
and 25 Eastern passages	13 11 46	12 15 53	13 1
Shortest passages	10 9 0	10 17 0	10 13
Bremen Line—Average of 20 Eastern			
and 22 Western passages	14 8 27	12 9 42	13 9
Shortest passages	10 17 0	10 19 0	10 18

From the above it will be seen, that while the mean average of all the passages, made between Liverpool or Southampton and New York, ranges from 11 days up to 13 days 9 hours; it is estimated that by Ireland, Newfoundland, and Shippigan, the passage could be made in 7 days 3 hours, nearly four days less time than the lowest mean average, and two days less than the shortest of 246 passages, if not the *very shortest* passage on record. These advantages alone are sufficient to attract the attention of business men, but the great recommendation of the Newfoundland route to most travellers, would be the shortening of the Ocean passage proper, from 264 hours (the average by the Cunard line) to 100 hours.

The above comparison has been made because the greatest number, and perhaps the best, Ocean Steamship Lines run to New York. A similar comparison with the Boston, Portland, and Quebec lines, would show a result still more in favor of the Newfoundland route.

The following table, giving the time required between London and various points in North America, will show at a glance the great advantage which would accrue to the people of both hemispheres by the establishment of *the short Ocean passage route.* By this table it will be seen that the Mails from London, could not only be carried to all parts of the British Provinces, and to all points in the Northern States, in a marvellously short space of time by the route herein projected, but that it is quite possible to deliver them on the shores of the Gulf of Mexico *in nine days,*—less time, in fact, than the shortest passages of the Cunard or of any other Steamers between Liverpool and New York.

Time required to carry the Mails by the Proposed Short Ocean Passage, and by the Intercolonial Railway from Shippigan.

From London to	St. Johns, N.F.	4	days	20	hours.
" "	Shippigan	5	"	20	"
" "	Halifax	6	"	5	"
" "	St. John, N. B.	6	"	4	"
" "	Quebec	6	"	10	"
" "	Montreal	6	"	16	"
" "	Toronto	7	"	2	"
" "	Buffalo	7	"	6	"
" "	Detroit	7	"	8	"
" "	Chicago	7	"	20	"
" "	Albany	7	"	0	"
" "	New York	7	"	3	"
" "	Boston	6	"	19	"
" "	Portland	6	"	15	"
" "	New Orleans	9	"	0	"

Having shown that by shortening the ocean passage across the Atlantic to a *minimum*, the time of transit between the great centres of business in Europe and America can be very greatly reduced; so much so indeed, that a reasonable hope may be entertained that the entire Mail matter passing between the two Continents, may eventually be attracted to the new route, it may be well now to enquire what proportion of passengers may be expected to travel over it.

Before 1838 the only mode of crossing the Atlantic was by sailing ships: the passage commonly occupied from six to ten weeks, until the introduction of a superior class of vessels known as the American Liners; these fine ships made an average homeward passage of 24 days, and an average outward passage of 36 days.

The year 1838 saw the beginning of a New Era in transatlantic communications. Two Steam vessels crossed from shore to shore; one, "The Sirius," left Cork on April 4th, another, "The Great Western," left Bristol on April 8th, and they both arrived at New York on the same day, the 23d of April; the average speed of the former was 161 miles per day, that of the latter 208 miles per day.

"The Great Western" continued to run from 1838 to 1844, making in all 84 passages; she ran the outward trip in an average time of 15½ days, and the homeward trip in an average time of 13¼ days.

The Cunard Line commenced running in July, 1840, with three steamers, "The

Britannia," "The Acadia," and "The Caledonia," under a contract with the British Government to make monthly passages.

In 1846, under a new contract, the Cunard Company undertook to despatch a Mail Steamer once a fortnight from Liverpool to Halifax and Boston, and another Mail Steamer once a fortnight from Liverpool to New York. This service has been maintained with amazing regularity and increasing efficiency to the present day.

These were the pioneers of a system of Ocean Steam Navigation which has already done so much to increase the intercourse between the two continents. By reducing the length and uncertainty of the voyages as well as the inconveniences, in many cases, the miseries, which passengers had previously to endure, a vast deal of good has been accomplished.

The number and tonnage of steamships engaged in carrying passengers and goods between the British Islands and North America, has of late years increased with wonderful rapidity. In 1864 no less than *ten regular lines* of Ocean steamers were employed in running either to New York or to ports north of that city in the United States or in Canada. Of these ten lines, two were weekly and eight fortnightly, equivalent in all to six weekly lines; so that there were on an average six steamships leaving each side weekly, or nearly one every day.

The total number of passengers carried by these various Steam lines during the past year was 135,317, and by far the largest number travelled during the Summer months.

It would not take a very large proportion of Passengers crossing in any one year to give employment to *a daily line of Steamers* on the short Ocean Passage route from St. John to Valentia or to Galway. A total number of 4,000 each way would give 200 passengers each trip, for seven months in the year.

It is obvious then that there is already abundance of Passenger traffic, if the purely passenger route under discussion, possesses sufficient attractions. To settle this point the advantages and disadvantages of the route must be fairly weighed.

The obstructions offered by floating ice during several months in the year, are insuperable while they last; during this period Halifax or some equally good port, open in winter, will be available.

The frequent transhipments from Railway to Steamship, and *vice versa*, may be considered by some an objection to the route; for conveyance of Freight they certainly would be objectionable, but most passengers would probably consider the transhipments, agreeable changes, as they would relieve the tedium of the journey.

With regard to the comparative safety of this route, it would seem as if the advantages were greatly in its favour. The portion of a voyage between New York and Liverpool, which seamen least fear, is that from Ireland to Newfoundland. It is well known that the most dangerous part of the whole voyage is along the American coast between New York and Cape Race, where thick fogs so frequently prevail; this coast line is about 1,000 miles in length, and it has been the scene of the larger number of the disasters which have occurred. No less than fourteen or fifteen Ocean Steamships have been lost on this portion of the Atlantic Seaboard.

The route which favours increased security from sea-risks, and which is the shortest in point of time, must eventually become the cheapest, and in consequence the most frequented. If then the route proposed across Newfoundland and Ireland avoids many of the dangers of existing routes, and reduces the Ocean passage proper to 100 hours, would not the current of travel naturally seek this route in preference to others, during the open season?

If, as it has been shewn, this route would reduce the time between London and New York some three or four days, and bring Toronto one third nearer Liverpool (in time) than New York is now; if it would give the merchant in Chicago his English letters four or five days earlier than he has ever yet received them; if it be possible by this proposed route to lift the mails in London and lay them down in New Orleans in less time than they have ever yet reached New York, then it surely possesses advantages which must eventually establish it, not simply as an Inter-Colonial, but rather as an Inter-Continental line of communication.

These are purely commercial considerations, and however important they may be as such, the Statesman will readily perceive, in the project, advantages of another kind. It may be of some consequence to extend to Newfoundland, as well as to the other Provinces of British America, the benefits of rapid inter-communication. It will probably accord with Imperial policy to foster the Shipping of the Gulf, and to encourage the building up of such a Fleet of swift Steamers as a Daily Line across the Ocean would require. It must surely be important to the Empire, to secure in perpetuity the control of the great Highway between the two Continents. It must be equally her policy to develop the resources and promote the prosperity of these Colonies—and to bind more closely, by ties of mutual benefit, the friendly relationship which happily exists between the people on both sides of the Atlantic."

THE ENGINEERING STAFF.

1863 to 1876.

Gentlemen engaged with the Engineer-in-Chief in the reconnoissance made during the winter of 1863–64.

Those recorded in italics are now dead.

W. H. Tremaine,	H. J. Cambie,
J. Royer Smith,	*John Fleming,*
Alex. Fraser,	*H. Bradley.*

Staff on the Exploratory Survey.

1864.

Those recorded in italics are now dead.

Engineers in Charge.

David Stark,	W. H. Tremaine,
Walter Lawson,	Tom S. Rubidge,

S. Hazlewood.

Assistants.

H. J. Cambie,	Edward Lawson,
J. F. Gaudet,	W. B. Leather,
G. McGuire,	*A. Williamson,*

W. G. Bellairs.

Junior Assistants.

C. Blackwell,	E. H. Keating,
J. F. Darwell,	*J. R. Smith.*

Explorers.

H. Bradley,	*Alex. Fraser.*

Staff on the Preliminary Survey.

1865.

W. H. Tremaine,

D. Stark,	S. Hazlewood,
H. J. Cambie,	S. Parker Tuck,
Thomas Ramsay,	C. Odell.

Staff on the Preliminary Survey.

1867.

W. H. Tremaine,	S. Hazlewood,
C. Odell,	James Odell,
H. A. F. MacLeod,	Henry Carre,
Wm. Hazen,	W. G. Bellairs,
E. W. Jarvis,	E. H. Keating,
J. R. Smith,	J. Jellett,
H. Donkin,	Alex. Schurman,
W. Dale Harris,	W. Johnston,
H. A. Gray,	C. H. McLeod.

Staff on the Location Survey.

1868.

Chief Engineer's Office.

W. J. Forrest, Assistant,
T. R. Burpe, Secretary.

District Engineers.

C. Schreiber,
W. H. Tremaine,
Marcus Smith,
S. Hazlewood.

Engineers in Charge.

W. H. E. Napier,
P. A. Peterson,
R. McLennan,
Henry Carre,
H. A. F. MacLeod,
R. Shanly,
W. M. Buck,
J. R. Hartley,
John Lindsay,
Wm. Hazen,
E. Lawson.

Assistant Engineers.

L. G. Bell,
Thos. Reynolds, Junr.
J. J. McGee,
W. McPhillips,
Wm. Murdoch,
G. H. Garden,
Colin Carman,
E. A. Harris,
R. Carr Harris,
W. D. Harris,
E. H. Keating,
J. R. Smith,
A. Bristow,
James Cadman,
J. E. Morse.

Juniors.

H. S. Langton,
H. N. Ruttan,
G. R. Fellowes,
J. Jellett,
W. McCarthy,
J. A. Dickey,
P. S. Archibald.

Staff on Location and Construction.—1869.

Chief Engineer's Office.

W. J. Forrest, Assistant,
T. R. Burpe, Secretary.

District Engineers.

Marcus Smith,
S. Hazlewood,
A. L. Light,
W. H. Tremaine.

Engineers in Charge.

L. G. Bell,
W. F. Biggar,
R. McLennan,
P. A. Peterson,
T. S. Rubidge,
E. Lawson,
F. J. Lynch,
W. M. Buck,
W. H. E. Napier,
John Lindsay,
Henry Carre,
R. Shanly,
C. Odell,
H. A. F. MacLeod,
W. J. Croasdale,
G. H. Henshaw.

Assistant Engineers.

Thos. Reynolds, Jr.,
L. Chandler,
A. Bristow,
J. R. McDonell,
F. Bolger,
C. Blackwell,
B. D. McConnell,
A. J. Hill,
J. B. Hegan,
J. L. P. O'Hanly,
E. A. Wilmot,
E. H. Keating,
J. F. Darwall,
Colin Carman,
Wm. Murdoch,
T. D. Taylor,
J. J. McGee,
G. E. McLaughlin,
J. C. Brown,
R. C. Harris,
E. A. Harris,
G. H. Garden,
J. W. Roberts,
P. Woodgate,
Thos. Ramsay,
J. Royer Smith,
E. W. Jarvis,
H. Donkin.

Juniors.

H. S. Langton,
G. R. Fellowes,
H. N. Ruttan,
P. S. Archibald,
W. McCarthy,
J. Jellett,
C. Morse,
J. A. Dickey.

Staff on Construction.—1870.

Chief Engineer's Office.

W. J. Forrest, Assistant. T. R. Burpe, Secretary.

District Engineers.

Samuel Hazlewood, Marcus Smith,
A. L. Light, W. H. Tremaine.

Engineers in Charge.

L. G. Bell, R. McLennan,
H. J. Cambie, W. H. E. Napier,
P. A. Peterson, John Lindsay,
W. F. Biggar, W. G. Bellairs,
E. Lawson, C. Odell,
W. J. Croasdale, Peter Grant,
Henry Carre. W. G. Thompson,
F. J. Lynch, W. M. Buck,
W. J. Fitzgerald, H. A. F. MacLeod,
W. B. Smellie, G. H. Henshaw.

Assistant Engineers.

Thos. Reynolds, Jr., Wm. Murdoch,
G. E. McLaughlin, J. C. Brown,
A. Bristow, J. J. McGee,
H. S. Langton, F. Bolger,
J. R. McDonell, T. D. Taylor,
L. Chandler, G. R. Fellowes,
J. B. Hegan, J. W. Roberts,
Colin Carman, B. D. McConnell,
G. H. Garden, H. Donkin,
L. B. Hamlin, J. F. Darwall,
R. C. Harris, Wm. Gossip, Jr.,
J. Royer Smith, E. W. Jarvis,
E. H. Keating, P. S. Archibald,
C. Blackwell, E. A. Wilmot,
P. Woodgate, J. L. P. O'Hanly,
H. P. Bell, A. J. Hill.

Juniors.

W. McCarthy, H. N. Ruttan,
C. Morse, J. Jellett,
P. S. Archibald, J. A. Dickey.

Staff on Construction.

1871.

Chief Engineer's Office.

W. J. Forrest, Assistant. T. R. Burpe, Secretary.

District Engineers.

W. H. Tremaine. A. L. Light,
Marcus Smith, Samuel Hazlewood.

Engineers in Charge.

C. Schreiber, L. G. Bell,
H. J. Cambie, J. R. McDonell,
John Lindsay, Henry Carre,
W. G. Bellairs, Peter Grant,
W. G. Thompson, H. A. F. MacLeod,
E. Lawson, W. J. Fitzgerald,
C. Odell, W. B. Smellie,
W. M. Buck, F. J. Lynch,
P. A. Peterson, G. H. Henshaw,
T. S. Rubidge, C. Blackwell,
W. J. Croasdale.

Assistant Engineers.

Thos. Reynolds, Jr., T. D. Taylor,
L. Chandler, H. S. Langton,
L. B. Hamlin, G. E. McLaughlin,
F. Bolger, J. C. Brown,
G. W. McCready, J. J. McGee,
G. R. Fellowes, J. B. Hegan,
R. Carr Harris, J. Royer Smith,
E. W. Jarvis, Wm. Gossip, Jr.,
E. A. Wilmot, J. A. Dickey,
H. Donkin, H. P. Bell,
G. H. Garden, A. J. Hill.

Juniors.

W. McCarthy, C. Morse,
H. N. Ruttan, J. Jellett,
P. S. Archibald.

INDEX.

Staff on Construction.

1872.

Chief Engineer's Office.

W. J. Forrest, Assistant.
T. R. Burpe, Secretary.

District Engineers.

A. L. Light,
L. G. Bell,
Samuel Hazlewood,
C. Schreiber.

Engineers in Charge.

H. J. Cambie,
John Lindsay,
J. R. McDonell,
W. G. Bellairs,
W. G. Thompson,
H. A. F. MacLeod,
Peter Grant,
W. B. Smellie,
W. J. Fitzgerald,
F. J. Lynch,
W. M. Buck,
W. J. Croasdale,
C. Blackwell,
P. A. Peterson,
E. Lawson,
C. Odell.

Assistant Engineers.

H. S. Langton,
T. D. Taylor,
W. McCarthy,
J. J. McGee,
G. R. Fellowes,
Jas. Cadman,
G. W. McCready,
J. C. Brown,
G. H. Middleton,
J. B. Brophy,
R. Carr Harris,
H. N. Ruttan,
J. Jellett,
G. H. Garden,
C. Morse,
H. Donkin
Wm. Gossip, Jr.,
P. S. Archibald,
E. A. Wilmot,
L. B. Hamlin,

J. B. Hegan.

Staff on Construction.

1873.

Chief Engineer's Office.

W. J. Forrest, Assistant. T. R. Burpe, Secretary.

District Engineers.

L. G. Bell,
A. L. Light.
Samuel Hazlewood,
C. Schreiber.

Engineers in Charge.

H. J. Cambie,
John Lindsay,
Peter Grant,
W. J. Fitzgerald,
W. M. Buck,
H. A. F. MacLeod,
J. R. McDonell,
W. G. Bellairs,
C. Odell,
W. B. Smellie,
F. J. Lynch,
W. J. Croasdale,
C. Blackwell.

Assistant Engineers.

J. J. McGee,
W. McCarthy,
L. B. Hamlin,
J. B. Hegan,
H. Donkin,
Wm. Gossip, Jr.,
G. H. Middleton,
E. A. Wilmot,
James Cadman,
G. W. McCready,
T. D. Taylor,
H. N. Ruttan,
C. Morse,
R. C. Harris,
H. Donkin,
J. Jellett,
G. R. Fellowes,
G. H. Garden

Staff on Construction.

1874.

District Engineers.

C. Schreiber,	S. Hazlewood,
L. G. Bell,	A. L. Light.

Engineers in Charge.

H. J. Cambie,	J. R. McDonell,
Peter Grant,	W. J. Fitzgerald,
W. B. Smellie,	F. J. Lynch,
W. M. Buck,	C. Blackwell,
H. A. F. MacLeod,	C. Odell.

Assistant Engineers.

T. D. Taylor,	G. H. Middleton,
H. S. Langton,	G. R. Fellowes,
W. McCarthy,	H. N. Ruttan,
L. B. Hamlin,	G. H. Garden,
James Cadman,	C. Morse,

P. S. Archibald.

Staff on Construction.

1875.

Superintending Engineer.

C. Schreiber.

Resident Engineers.

Peter Grant,	W. B. Smellie,
C. Blackwell,	J. R. McDonell,
P. S. Archibald,	W. McCarthy,
A. Sinclair,	W. Mann.

Staff on Construction.

1876.

Superintending Engineer.

C. Schreiber.

Resident Engineers.

Peter Grant,
C. Blackwell,
P. S. Archibald,
A. Sinclair,
W. B. Smellie,
J. R. McDonell,
W. McCarthy,
W. Mann.